

ROLLING THUNDER TO LINEBACKER: U.S. FIXED WING
SURVIVABILITY OVER NORTH VIETNAM

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Art of War Scholars

by

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ABSTRACT

ROLLING THUNDER TO LINEBACKER: U.S. FIXED WING SURVIVABILITY OVER NORTH VIETNAM, by LCDR Douglas M. White, 145 pages.

The Vietnam War contained two major air campaigns, Operations Rolling Thunder (March 2, 1965-March 31, 1968) and Linebacker I (May 10, 1972-October 23, 1972). They each had the strategic goal of deterring North Vietnam's assistance to the Viet Cong in South Vietnam. During the peak year of operations in Rolling Thunder, 1967, 321 U.S. aircraft were lost, vice 95 during Linebacker I. Once standardized by loss per sortie, an improving trend of survivability for U.S. aircraft is apparent. This thesis will examine why the Linebacker I offensive of the Vietnam War showed improved survivability for U.S. aircraft when compared to the operations of 1967 during Operation Rolling Thunder. It will examine the operational decision making of both operations and what effects this may have had on losses. It will examine the shortcomings and technical developments of U.S. airpower between 1965 and 1972. Furthermore, it will examine the evolution of North Vietnam's air defenses, and the U.S. tactics developed to counter this evolution. Finally, it determines the root causes of U.S. losses and the evolutionary improvements in material, tactics, and leadership that allowed an improving trend of survivability for U.S. tactical aircraft over the course of the conflict and identify lessons learned for future conflict.

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ACRONYMS

| | |
|--------------------|---|
| AAA | Anti-Aircraft Artillery |
| CHECO | Contemporary Historical Examinations of Current Operations |
| CINCPAC | Commander in Chief, Pacific Command |
| COMUSMACV | Commander, United States Military Assistance Command, Vietnam |
| DACT | Dissimilar Air Combat Maneuvering |
| DMZ | Demilitarized Zone |
| DRVAF ^c | Democratic Republic of Vietnam Air Force |
| EW/GCI | Early Warning/Ground Controlled Intercept |
| IADS | Integrated Air Defense System |
| JCS | Joint Chiefs of Staff |
| LOC | Line of Communication |
| MiG | Mikoyan and Gurevich |
| NVA | North Vietnamese Army |
| OPLAN | Operations Plan |
| POL | Petroleum, Oils, Lubricants |
| ROE | Rules of Engagement |
| SAM | SAM |
| SEA | SEA |

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CHAPTER 1

INTRODUCTION

The war in the air over North Vietnam was the United States air force's first truly modern war. While jet air combat was introduced in the skies over Korea, the widespread use of air-to-air, air-to-surface, and surface-to-air missiles was first seen in Vietnam. Furthermore, the use of force multipliers, such as air refueling, and force protection measures, such as airborne electronic countermeasures were first widely used by the United States in Vietnam.

The Vietnam War contained three major air campaigns against North Vietnam: Rolling Thunder, Linebacker I, and Linebacker II. They were all strategic bombing campaigns conducted with the goal of changing the North's view of South Vietnam, to end the support of the Viet Cong by the North, and in the end, to bring North Vietnam to the bargaining table. When pitted against the will of the North Vietnamese people, and against the "Long War" strategy of their leader, Ho Chi Minh, these strategic goals were destined to fail.¹ Rolling Thunder was the first of these campaigns, beginning in March of 1965. Over the next three years, a technique of escalation was used in order to attempt to bring the North Vietnamese to the table. Instead, it simply steeled the resolve of the North Vietnamese people. In the intervening years, the air war in the North was fought on a much more limited scale. Finally, in March of 1972, in response to the Easter Offensive, Operation Linebacker was initiated.

¹John T. Smith, *Rolling Thunder: The Strategic Bombing Campaign* (Surrey, Great Britain: Air Research Publications, 1994), 25.

For the next five and a half months, strategic military targets were struck in order to interdict primarily supply lines and change the course of the war in the South. In his book, *The Linebacker Raids* published in 2000, John T. Smith concludes that during Rolling Thunder, the U.S. could fly 650 sorties for the loss of a single aircraft. He also contends that nearly four years later, the number had dropped to 555 sorties per loss; thus demonstrating a negative trend of U.S. fixed wing survivability in the skies above North Vietnam.² Using declassified Contemporary Historical Examinations of Current Operations (CHECO) reports, some of which were only released in 2006, and Chris Hobson's *Vietnam Air Losses: United States Air Force, Navy and Marine Corps Fixed Wing Aircraft Losses in SEA 1961-1973* published in 2001, these numbers were recalculated and tell a different tale.

Using the same method for calculation, the numbers would indicate that 189,000 sorties were flown during 1967 as a part of Rolling Thunder, with the loss of one aircraft for every 591 sorties. Roughly 74,000 sorties were flown in Linebacker, with the loss rate at one aircraft for every 777 sorties.³ This would indicate a positive trend of U.S. aircraft survivability in the most vigorously defended target areas in North Vietnam. This

²John T. Smith, *The Linebacker Raids* (New York: Sterling Publishing Co, 2000), 206.

³The loss per sortie calculation for 1967 was derived from sortie count information from the Headquarters United States Military Assistance Command Vietnam (HQ USMACV), *Official MACV Command History, Vol. I, 1967* (Washington, DC: Government Printing Office, 1968), 428, and from review of the 1967 air losses contained in Chris Hobson, *Vietnam Air Losses: United States Air Force, Navy and Marine Corps Fixed Wing Aircraft Losses in SEA 1961-1973* (Hinckley, England: Midland, 2001). Calculation data for the Linebacker I offensive was sourced from the Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER Operations: September-December 1972* and from review of the air losses during the Linebacker I timeframe included in Hobson.

positive trend is to be expected given the advancements in tactics, aircraft, and weaponry in the intervening years between the two campaigns. The determination of what factors led to the increase in survivability will be the primary objective of this thesis.

Overall, the U.S. air forces had improved in the intervening period between 1968 and 1972. The United States made vast improvements in tactics, aircraft and weaponry during that period to include operational deployment of a new generation of dedicated electronic warfare aircraft such as the EA-6B Prowler, new attack aircraft such as the LTV A-7 Corsair II, precision guided weapons such as the Paveway laser guided bomb, the Walleye optically guided bomb, and terrain following technologies that allowed nap of the earth flight to evade North Vietnamese radars, such as developed in the F-111 Aardvark.

In order to find the root cause of this increase in survivability, the mode of shoot down or loss of each aircraft must be ascertained. *Vietnam Air Losses: United States Air Force, Navy and Marine Corps Fixed Wing Aircraft Losses in SEA 1961-1973*, is a remarkable resource for determining this as it offers a short summary of aircraft type, mission, and circumstances surrounding each loss. From there, the loss can be categorized as resulting from mission, aircrew error, weather, etc. This will become part of the mosaic that lends itself to the overall picture or possible common theme that will divulge the cause of the decrease in loss per sortie in Linebacker operations.

The increase in threat density in the North during the course of the war can also not be underestimated. From its meager beginnings in 1965 to becoming what was the most dense air defense system in the world by 1972, the North Vietnamese defenses were allowed to be systematically built up and replenished throughout the war. Advances in

technology such as the integration of the North Vietnamese air defense system and the proliferation and replenishment of SA-2 Guideline Surface-to-Air Missile (SAM) sites and MiG-21 Fishbed fighter aircraft made for a much more dangerous environment for U.S. fliers in 1972. *Victory in Vietnam: The Official History of the People's Army of Vietnam, 1954–1975* gives a detailed account from the view of the North Vietnamese regarding the buildup, reorganization, and changes in tactics used in the North over the course of the war.

Chapter 2 will examine the design methodology used to analyze the data from the Rolling Thunder 1967 operations totals and from the Linebacker I campaign in 1972. Mathematical basis for sample size calculations and degree of certainty will be reviewed and applied to the collected data for analysis.

Chapter 3 will provide background and context by examining the Rolling Thunder Campaign of 1965-1968 to include an overview, a discussion of the campaign's objectives, targeting methods used, aircraft and tactics, threat environment, and weaponry. Chapter 4 will examine training factors, as well as service policies towards pilots and endurance. This chapter will lay the foundation for the analysis of the losses of Linebacker, as it will provide a benchmark for performance of U.S. airpower in Vietnam. Began in 1962 at the behest of the Chief of Staff of the Air Force, CHECO reports contain data sifted from operations reports and other official records. Project CHECO reports are available that span the entirety of Rolling Thunder, offering insight into the overall U.S. effort, as well as Military Assistance Command, Vietnam reports. *Alpha Strike: Vietnam* gives firsthand accounts of the U.S. Navy side of operations in 1967.

Chapter 5 will detail the operations of Linebacker I from May to October 1972. It will discuss the evolution of U.S. weapons systems and tactics in the period of 1968-1972, the intervening years between the two campaigns. Follow on aircraft, revisions or emergence of new tactics, and new weapons, specifically the emergence of guided weapons will be covered. Electronic warfare advancements will also be discussed. It will also examine differences in targeting, the major change being the move away from targeting decisions being made from Washington, DC, and being moved to theater level command. In addition, the removal of target restrictions will be discussed, and what influence that might have had on losses.

Interviews and emails conducted with aircrew of the period provide firsthand accounts and ground truth at the tactical level. Specifically: Lieutenant Colonel William Schwertfeger, U.S. Air Force (Retired) was shot down in an F-4 on February 16, 1972 by an optically guided SA-2F surface-to-air missile just prior to the Easter Offensive in Route Package I north of the Demilitarized Zone (DMZ). At the time of his shoot down, he had flown over 350 missions and was on his second tour in Southeast Asia (SEA). Colonel Roger Locher, U.S. Air Force (Retired) had spent over two-and-a-half years in SEA and had three MiG kills and over 500 missions to his credit when shot down in his F-4 by a MiG-19 on the opening day of Linebacker I, May 20, 1972. Colonel Charles DeBellevue, U.S. Air Force (Retired) ended the war as the leading U.S ace with six MiG kills as an F-4 Weapons Systems Officer. These gentlemen constitute the top tier of Air Force aviators of the period.

From the naval perspective, Lieutenant Commander John Pianetta, U.S. Navy (Retired) was on his second deployment onboard USS *Kittyhawk* when Linebacker began

flying the newest and most advanced aircraft in the fleet, the LTV A-7E Corsair II. A veteran of 229 combat missions over North Vietnam during Linebacker, including 34 Alpha Strikes, he took part in the entire campaign, from mining Haiphong harbor to striking targets in Hanoi. A lieutenant at the time of Linebacker, his perspective is one of a seasoned and tactically excellent junior officer.

Furthermore, the People's Army of Vietnam's air defenses will be compared and contrasted from the Rolling Thunder years to immediately prior to the start of Linebacker I in May 1972. Any differences will be noted, to include introduction of new radars, surface-to-air missiles, changes in threat density and improvements to operator training. *Powerful and Brutal Weapons: Nixon, Kissinger, and the Easter Offensive* offers great insight into the improvements to the People's Army of Vietnam's air defenses immediately before the commencement of Linebacker.

Finally, the operations of Linebacker I from May to October 1972 will be detailed. Strategic objectives will be examined, as well as campaign methods to gain insight to the losses. Tactics used, aircraft used, and weapons used, as well as targeting decisions and threat density will all be analyzed in order to identify root causes of the loss rate. Both sides of this narrative are available through recently unclassified Project CHECO reports: *Project CHECO Report: LINEBACKER: Overview of the First 120 Days* and *Project CHECO Report: LINEBACKER Operations September-December 1972* directly providing Pacific Air Force's assessment of the campaign, as well as many others, and *Victory in Vietnam: The Official History of the People's Army of Vietnam, 1954–1975* offering the North Vietnamese account of the operation.

Chapter 6 will summarize and present the combined analysis of factors and evidence to support conclusions for the attribution of losses and the factors that caused the increased survivability of U.S. aircraft in a deadlier environment than they had experienced just five years before.

CHAPTER 2

DESIGN METHODOLOGY

The design methodology used will primarily examine the loss of aircraft per sortie flown. A sortie being defined as the single flight of one combat aircraft from takeoff to landing. When comparing two populations, in this case, sorties flown in Rolling Thunder and sorties flown in Linebacker, it is important to make the two sample sizes as equivalent as possible. Given that Linebacker was only a period of five and a half months, compared to over three years for Rolling Thunder, its population of sorties becomes the limiting factor in sample size at 73,899 sorties.

In order to reduce the sample size from the population of Rolling Thunder sorties, the Rolling Thunder campaign must be examined. Rolling Thunder, as a whole, contained over 297,000 sorties. Each year or phase of Rolling Thunder contained different target sets, governed by varied Rules of Engagement (ROE). Furthermore, due to the escalating nature of the overall strategy, many heavily defended targets were not struck until the latter stages of the operation. The year 1968 might well have been the peak of these operations had the weather in the first quarter not been abysmal, followed by a series of bombing limitations by the Johnson administration that removed the most heavily defended targets around Hanoi and Haiphong from consideration and eventually ended Rolling Thunder in October of 1968. Due to this reduction in operations in 1968, 1967 is generally considered the peak of U.S. air operations over North Vietnam during Rolling Thunder.

After review of the 1966 operations, Admiral U.S. Grant Sharp, Commander in Chief, Pacific Command (CINCPAC) set out to provide strategy to support U.S. policy

objectives in 1967. Specifically to Rolling Thunder, that the objective was twofold: first, “To apply steadily increasing pressure against North Vietnam to cause Hanoi to cease its aggression in South Vietnam;” and second, “Make continued support of the Viet Cong insurgency as difficult and costly as possible.”⁴ Tasks to accomplish this objective were delineated as such: first, “Reduce or deny external assistance to North Vietnam;” second, “Disrupt and destroy in depth those resources that contribute most to the support of aggression;” and third, “Harass, disrupt, and impede the movement of men and materials to Laos and South Vietnam.”⁵ One of the lessons learned from review of the 1966 campaign was “that a gradual, drawn-out, and cautiously constrained air campaign created very little psychological impact on the NVN leaders and populace.”⁶ For 1967, the force of Rolling Thunder was to be “amplified in three ways: more targets were authorized for strike; many of the newly approved targets lay farther north, nearer the source of the enemy’s strength; and finally, the fleet of strike aircraft had become for effective through increased numbers, modernization, new munitions and improved tactics.”⁷ This philosophy was essentially the same used during 1972. Thus, to reduce the sample size from Rolling Thunder, and to create a more equitable comparison with regard to target sets and more liberal ROE that were characteristic of Linebacker, the year 1967 was chosen.

⁴Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER January 1967-November 1968* (Washington, DC: Government Printing Office, 1969), 1.

⁵Ibid.

⁶Ibid., 4.

⁷Ibid.

Taken as a whole, Rolling Thunder operations over the North in 1967 contained 189,736 sorties.⁸ This number contains both what were classified as combat sorties (strike, flak suppression, armed reconnaissance, combat air patrol or rescue combat air patrol) and combat support sorties (reconnaissance, electronic countermeasures, refueling, airborne early warning, leaflet drops, etc.). Unfortunately, a similar breakout of sorties for Linebacker I is not available, and as such, the total sortie count for the mission type in each operation must be used. This may result in a slightly skewed measure of survivability, since many combat support sorties were not in harm's way. However, the measure will be placed equitably over both samples.

Next in the effort to carve down the Rolling Thunder sample would be to limit the sample to only the sorties flown during the same time period during the year as Linebacker I. Unfortunately, monthly sorties totals for 1967 were not published as the monthly totals for 1965, 1966, and 1968 were in their corresponding Project CHECO report.

Luckily, owing to the Northwest Monsoon, the first and last quarter of every year's weather over North Vietnam was questionable for daylight delivery of conventional ordnance. These weather patterns partially dictated the North's Easter Invasion timeline during 1972, and thus, the American response of Linebacker. Starting in April however, the weather becomes very favorable for conventional ordnance delivery, generally until the October timeframe, when it begins to deteriorate once again.

⁸HQ USMACV, *Military Assistance Command Vietnam Command History, 1967*, 428.

Ideally, the same time period, May through October, would be examined for comparison in order to ensure comparable weather conditions between the two samples.

Unfortunately, sortie information is not available for individual months in 1967, and so the entire year's sortie count will be included, as well as the total fixed wing air losses over the North for the year. Historically, operations over the North were hampered by the weather during the winter months, and the sorties diverted to the South, where the weather was favorable. Therefore, the inclusion of the sorties from these winter months over the North constitutes only a small fraction of the total sorties for the year.

Selection of 1967 for comparison also avoids any potential skewing of sorties caused by the bomb shortage of 1966, where aircraft were launched with only minimal ordnance on board; a condition caused by the marriage of ordnance rationing due to shortages with the drive for high sortie rates, which were a measure of perceived success in the Johnson administration, due to then Secretary of Defense Robert McNamara's policies.

Next, the other half of the calculation must be examined. There is a wide variety of reasons why aircraft losses not directly attributable to combat action might be included in official statistics; to more easily secure replacement aircraft procurement funding for example. Many times combat losses include what are in peacetime considered operational losses, such as crashes during take-off or landing, or other aircraft malfunctions that could have just as easily occurred in peacetime. Purely by virtue of these accidents or episodes occurring within the confines of a combat theater, they are then included as a combat loss. Obviously, to get a true measure of U.S. aircraft combat losses over North Vietnam, ideally each loss would be examined.

Through the use of the detailed accounts of each loss available in *Vietnam Air Losses: United States Air Force, Navy and Marine Corps Fixed Wing Aircraft Losses in SEA 1961-1973*, each aircraft loss was reviewed, and the pertinent information regarding the loss was entered into a database in order to analyze the data. Criterion for inclusion into the category of lost as a result of action over North Vietnam includes aircraft shot down over the North, (whether by small arms fire, anti-aircraft artillery (AAA), SA-2 Guideline Surface to Air missile, or by Democratic Republic of Vietnam Air Force (DRVAF) MiG fighter aircraft), and aircraft that crashed due to controlled flight into terrain while operating over the North caused by poor weather or by pilot error or spatial distortion. In a few rare cases, the cause of the loss is not known, only that the aircraft failed to return from its mission over the North; these losses are also included. Operational losses such as crashes during take-off or landing, engine failures, or other causes not directly attributable to action with the enemy were not included for analysis.

Additionally, other information about each loss was entered into a database, to include the date of the loss, the service, the type of aircraft, the rank of the pilot, what the cause of the loss was (small arms, AAA, MiG, controlled flight into terrain, or unknown) and the general vicinity of the loss. When available, the altitude and speed of the aircraft was noted, as well as the size of AAA used to down the aircraft. Night and weather influenced combat losses were also noted as a contributing factor due to reduced visibility. This data will also be analyzed to provide possible conclusions regarding experience level of the pilot (somewhat attributable to rank), aircraft type (improvement in later variants or replacement types for the same mission may show increased

survivability), and weapon used to down the aircraft (trends in weapons may show revision in tactics).

Through the combinations of these sources, the sortie counts for 1967 and for Linebacker I in May through October of 1972 were tabulated, as well as the overall losses for the same periods, after screening them for inclusion as a combat loss as described above. The results for 1967 showed 189,736 sorties and 321 aircraft lost to the effects of combat for one combat loss per 591 sorties.⁹ Linebacker I data included 73,899 sorties for the loss of 95 aircraft, resulting in one loss per 777 sorties.

The subsequent chapters of this thesis will examine the factors that caused the improvement in U.S. fixed wing aircraft survivability in Linebacker I, and attempt to identify, if any, root cause of the improvement.

⁹The loss per sortie calculation for 1967 was derived from sortie count information from the HQ USMACV, *Military Assistance Command Vietnam Command History, 1967*, 428, and from review of the 1967 air losses contained in Hobson. Calculation data for the Linebacker I offensive was sourced from the Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER Operations: September-December 1972*, 93 and from review of the air losses during the Linebacker I timeframe included in Hobson.

CHAPTER 3

ROLLING THUNDER

It is easier to get into a war than to get out of it.

— U.S. Secretary of State Henry Kissinger,
quoted in Thompson, *Rolling Thunder*

Introduction

To fully understand the launch of Operation Rolling Thunder, one must examine the events leading up to the first Rolling Thunder strikes on March 2, 1965. The common belief is that Rolling Thunder was an outgrowth of the Flaming Dart airstrikes that preceded it in February 1965, and while to some extent this is true, the true path to the start of Rolling Thunder began years earlier. The atmosphere of the Cold War made covert actions particularly attractive to several U.S. administrations due to their deniability.¹⁰ In the vein of this utility, a plan was devised in September of 1963 named Operations Plan 34-63 (OPLAN 34-63). Developed by CINCPAC, OPLAN 34-63 was designed to increase pressure on the North Vietnamese so that “faced with the credible prospect of losing its industrial and economic base through direct attack, [the North Vietnamese] would halt its support of the insurgencies in Laos and South Vietnam.”¹¹ Three months later, President Johnson signed a slightly modified version of this plan dubbed OPLAN 34-A.

¹⁰James Clay Thompson, *Rolling Thunder: Understanding Policy and Program Failure* (Chapel Hill: The University of North Carolina Press, 1980), 14.

¹¹*Ibid.*, 16.

OPLAN 34-A was a 12-month program divided into three parts, designed to escalate in severity its effect on the North Vietnamese. The entire program was to be covert; ranging from U-2 and electronic intelligence flights to psychological operations and finally 20 destructive direct attacks made by South Vietnamese forces and third party mercenaries on behalf of the United States.¹² On August 2, 1964, North Vietnamese forces attacked the USS *Maddox*, which was conducting electronic surveillance of the North Vietnamese coast in international waters as part of OPLAN 34-A. It is speculated that perhaps it was confused for a South Vietnamese vessel that was in the area, shelling targets along the coast. A second event occurred two nights later, and in response, President Johnson authorized retaliatory strikes against North Vietnamese port facilities. This became known as the Tonkin Gulf crisis, and demonstrated American resolve to use air power in North Vietnam. To the American public, these attacks on U.S. warships seemed unprovoked; however, the use of covert action led to the use of overt action, and now fewer options remained to the Johnson administration.¹³ In the wake of the crisis, a list of additional targets was created in case there would be future need for retaliatory air strikes. In January of 1965, another patrol of destroyers embarked on an intelligence collection mission similar to the one in August. This time Operation Flaming Dart was in place, which provided for retaliatory attacks against the North Vietnamese in the event that the patrol was attacked. In February 1965, Flaming Dart was indeed used; however, it was in response to the Viet Cong bombing of the U.S. base at Pleiku in South Vietnam. A second Flaming Dart strike was ordered soon after, this time in retaliation for the

¹²Thompson, 17.

¹³Ibid., 21.

attacks on American enlisted billets at Qui Nhon.¹⁴ This “loosening of the reins” demonstrated a clear shift in U.S. strategy in Vietnam.¹⁵ This shift laid the foundation for the genesis of Operation Rolling Thunder.

The original plan for a sustained air campaign against North Vietnam envisioned a 12-week strategic bombing program against the small industrial center of North Vietnam. This was championed to be able to bring about the effect that the covert operations had failed to do—change the policy of the North Vietnamese government toward the South. Rolling Thunder began on March 2, 1965. It began in piecemeal strikes, carefully metering the combat power of the U.S. forces so as to not encourage intervention by China.¹⁶ This restraint also led to the targeting decisions being made in the White House, with the only variable being left to commanders being the exact day inside each weekly window that the target was struck.¹⁷ The United States was now embroiled in an air war in North Vietnam.

Rolling Thunder, 1965

On March 2, 1965, the first Rolling Thunder strike, known as Rolling Thunder V was launched against the Xom Bang Ammo Depot just north of the DMZ. Seasonal weather had precluded additional operations, (Rolling Thunder I-IV) from taking place, as well as political upheaval and a coup de tat staged in South Vietnam on February

¹⁴Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER March-June 1965* (Washington, DC: Government Printing Office, 1966), 1.

¹⁵Thompson, 28.

¹⁶Ibid., 30.

¹⁷Ibid.

25th.¹⁸ Several political restrictions hampered the conduct of these strikes, the most prominent being the mandate that South Vietnamese Air Force be included prominently in the makeup of the strike force. Thus, it was March 2nd before the combination of suitable weather and South Vietnamese Air Force aircraft being available occurred. The next mission did not occur until March 14th.

As the operation began to pick up speed, several restrictions were lifted by the Joint Chiefs of Staff. First and foremost, the targets could now be struck at any time during the seven-day period in which they had been assigned. Additionally, if a target was not struck during that period, they could be carried over into subsequent weeks. Second, aircraft based in Thailand could now be used, an agreement with the Thai government having been reached. Third, the requirement for South Vietnamese Air Force participation was lifted, and U.S. aircraft could be used to fill any gaps remaining. Fourth, the size of the strike package was not dictated. Enough aircraft could be used in order to reasonably satisfy the destruction requirements of a target. Fifth, armed reconnaissance missions with protective flak and combat air patrol aircraft assigned were authorized in order to interdict the flow of supplies and troops to the south. Finally, low and medium altitude reconnaissance flights for bomb damage assessment became authorized.¹⁹

The removal of these restrictions saw the rate of missions pick up significantly after March 19th, as well as the seasonal weather improving as the monsoon ended. The sortie counts quickly increased, with 1500 flown during the month of April, evenly

¹⁸Thompson, 16-21.

¹⁹Ibid., 26.

divided between the U.S. Air Force and the Navy. Targets were focused mainly on barracks, with a short campaign against nine radar sites that were believed to provide early warning of strikes from South Vietnam and from the aircraft carriers of Task Force 77 on Yankee Station positioned off the coast of North Vietnam.²⁰

An important aspect of these early stages is the strategic implications that the strikes were hoped to have. By restricting targeting to below the 20th parallel, the Johnson administration had hoped to demonstrate to the North Vietnamese American resolve, and to display shades of things to come for the North if they chose to continue on their current course of support to the Viet Cong in the South. This careful metering of American airpower was in theory meant to pressure the North while not provoking the ire of communist China or the Soviet Union. With this in mind, the Phase II of Rolling Thunder was launched on April 23rd with the emphasis on cutting lines of communication (LOC) to the South. Building off earlier strikes on key bridges in the area, this first day saw seven other key bridges below the 20th parallel dropped by U.S. strike aircraft.²¹

Early May brought a widening of the target set, with more traditional infrastructure being added such as barracks, supply depots, port facilities, airfields, and radar sites.²² Bomb damage assessments showed heavy damage to these targets, and a general mobilization of defense forces and overall defense posture throughout North Vietnam. Furthermore, a review of the first 14 weeks of Rolling Thunder operations by

²⁰Thompson, 27.

²¹Ibid., 43.

²²Ibid.

CINCPAC showed disruption of LOCs and the logistical framework supplying the Pathet Lao in Laos.²³ Yet there was still much to be done. In general, only 40-60 percent of the targets below the 20th parallel had been struck, with port facilities nearly entirely intact.

In light of these facts, Admiral Sharp put forward a comprehensive plan in alignment with the overall objective of Rolling Thunder. Specifically, to “destroy targets essential to the infiltration of men and material into Laos and South Vietnam within limitations imposed by higher authority.”²⁴ The CINCPAC plan stressed that the “U.S. should strive to convince North Vietnamese leadership that U.S. staying power was greater than theirs.”²⁵ The mechanism of this was to be the direct costs of losing physical infrastructure, but in the hopes of bending the will of the people, the air campaign should “generate pessimism and a feeling of helplessness amongst the military, and general frustration, anxiety, and fear among the civilian populace.”²⁶ A powerful round the clock offensive with specific emphasis on interdiction, operating within the political ROE constraints was proposed, with large numbers of additional armed reconnaissance sorties added to provide continual pressure on LOCs. Additionally, a psychological effort was prescribed to further demoralize the North Vietnamese people.²⁷ On May 13, 1965, a five-day pause was ordered by the Department of Defense to provide political breathing room for potential diplomatic talks with the North Vietnamese. This was to be the first

²³Thompson, 46.

²⁴Ibid., 51.

²⁵Ibid., 47.

²⁶Ibid.

²⁷Ibid., 50.

carrot offered by the Johnson administration after liberal use of the stick. The North used these pauses, in what became a common theme, to improve their advantages on the battlefield and counter U.S. actions. They became more adept at this as the war continued.²⁸

Immediately after this pause, the effort continued south of the 20th parallel. Desired targets were threefold: LOCs, military infrastructure, and thermal power plants. The concept of operations also consisted of three parts: organized strikes against fixed targets south of 20 degrees north longitude, armed reconnaissance flights to interdict truck movement, and now one strike a week was to be directed to a target in North Vietnam above the 20th parallel, an escalatory measure designed increase pressure on the North Vietnamese. These northern strikes were still restricted to areas outside a designated 40 nautical mile prohibited zone surrounding Hanoi.²⁹

By the beginning of July, the overall coordination and targeting guidance of the Rolling Thunder missions had greatly improved from its start in March. Full spectrum aerial warfare was now being waged by the United States, with the full utilization of support units, to include electronic countermeasures, aerial refueling, airborne early warning, and tactical reconnaissance. Armed reconnaissance target sets had been widened to include virtually any conveyance on land or water that could be used to carry material to the South. The majority of the targets south of the 20th parallel had been damaged or

²⁸Smith, *Rolling Thunder*, 73.

²⁹*Ibid.*, 52.

destroyed, and 91 of 117 Joint Chiefs of Staff (JCS) targets had been attacked, including 22 of 24 bridges either destroyed or heavily damaged.³⁰

Of concern to the U.S. forces was the MiG fighter threat operating from airbases in the North. Some airfields had been struck, but the main North Vietnamese fighter bases at Phuc Yen and Cat Bi in Hanoi and Haiphong respectively were veiled in the protective blanket of the prohibited area and were thus unable to be struck. Furthermore, the import and deployment of the SA-2 Guideline SAM in the spring of 1965 had not gone unnoticed. Instead of striking these sites as they were being built and thus still relatively defenseless, political pressure was applied to the ROE, and thus they too were unable to be struck until they actually fired upon a U.S. aircraft. This was to occur on July 24, 1965, when a U.S. Air Force F-4C was shot down.³¹ This was to signal an upping of the ante by North Vietnam, and was to begin an expansive effort by the United States to develop and field an effective countermeasure against the SA-2. While the missile itself did not impose the greatest number of losses proportionally, what it did do was force American aircraft down into the effective altitude of a plethora of smaller caliber AAA that had previously been avoided by flying at higher altitudes. The early warning radars that provided cueing for the North Vietnamese were stuck repeatedly in the first few months of Rolling Thunder but proved hard to destroy due to their mobility

³⁰Smith, *Rolling Thunder*, 66.

³¹*Ibid.*, 68.

and ease of repair.³² The North Vietnamese were well on their way to building the most concentrated integrated air defense system in the world.

In response to the growing air defense threat, the second half of 1965 saw the creation of Iron Hand missions in order to suppress the growing North Vietnamese air defenses. These missions specifically assigned aircraft to suppressing the AAA and missile sites. The first of these missions were conducted in August as part of the overall strike efforts against targets with little success. As summer turned into fall however, tactics were modified and successful attacks became more frequent.³³

The escalation of force used continued as the majority of the JCS targets in the south portion of North Vietnam had been thoroughly damaged or destroyed, including the overwhelming majority of bridges in the area. This served to isolate the southern city of Vinh, however Haiphong remained untouched, and the two major rail arteries from communist China to Hanoi were unscathed. This allowed an unfettered flow of supplies from China into North Vietnam. In light of this, the northwest rail line running from Hanoi to Lao Cai was initially targeted in July, and was subject to attacks through the rest of the year.³⁴ August and September saw a trend towards more armed reconnaissance sorties and few strikes against fixed targets as the interdiction efforts were raised.

By the last quarter of 1965, it was determined that by striking industrial targets in the North, the escalation could be effectively continued, and additional pressure could be

³²Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER March-June 1965*, 66.

³³Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 5.

³⁴*Ibid.*, 3.

placed on the communists. Furthermore, the arteries from communist China were selected for destruction. In October, the main railway and highway bridges along these routes were struck by both U.S. Air Force and Navy aircraft. These efforts continued throughout November, with the additional armed reconnaissance effort remaining high. The U.S. Air Force and Navy flew near to or over the 600 biweekly sorties allotted to each of them for this purpose, though poor weather on Yankee Station hampered naval aircraft operations. December also saw the continuation of the systematic destruction of road and rail bridges on the main arteries from China.³⁵

Perhaps the next marker of escalation was the attack against the Uong Bi Thermal Power Plant. This piece of critical infrastructure, producing 14 percent of North Vietnam's electrical power (and more importantly one-quarter of Hanoi's and one-third of Haiphong's) was the first industrial target selected for destruction by the United States. This signaled a new tightening of the noose, and an expansion into industrial targets meant to now cripple what little indigenous industrial capacity the North Vietnamese possessed. Navy A-6 Intruders crippled the plant on the night of December 22nd, placing an exclamation point on the U.S. efforts for the year before the next bombing pause beginning on Christmas Eve.³⁶

The first 11 months of Rolling Thunder, including Flaming Dart, had cost the United States 163 aircraft and had failed to bring North Vietnam to the bargaining table. Admiral Sharp voiced concerns to the JCS that without an increase in the efforts over

³⁵Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 16.

³⁶*Ibid.*, 19.

1965 levels, Rolling Thunder would not achieve its goals. Additionally, the gradual pressure applied over the course of the year had only served to begin to desensitize the North Vietnamese to the persuasion being attempted with air power. He suggested the closure of seaborne LOCs, including the mining of Haiphong harbor, the destruction of further selected industrial targets, and that the prohibited zones surrounding Hanoi and Haiphong be shrunk to 25 and eight nautical miles respectively. This would allow for further interdiction of supply lines.³⁷ Intelligence had shown that with the increase of LOC disruption, more material was now being carried on the backs of the people, and that while virtually all bridges had been reduced to rubble, fords were readily available in the dry season. Additionally, the northwestern rail line from China was repeatedly repaired and was in operation at year's end. It was apparent to CINCPAC that the 2,400 sorties dedicated per month to armed reconnaissance in 1965 had not been enough to stop the flow of supplies to the communist forces in South Vietnam.³⁸ Furthermore, the sanctuaries provided to Hanoi and Haiphong only served to give the North Vietnamese the means to resist, specifically the MiG bases in those zones.³⁹ CINCPAC's recommendations were to fall on deaf ears though as 1966 began.

Rolling Thunder, 1966

The year 1966 was marked by continued expansion of the effort in the skies above North Vietnam. Key leaders, including Admiral Sharp, CINCPAC, and General William

³⁷Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 22.

³⁸*Ibid.*, 20.

³⁹*Ibid.*, 23.

Westmoreland, Commander, U.S. Military Assistance Command, Vietnam (COMUSMACV) continued to lobby the JCS for an expansion of target lists to include industrial targets and port facilities. In the spring, operational administration was codified by the restructuring of air operations within the Route Package system to assign service responsibility to different areas in the North. With this came a new variation on the ROE, designed to expand interdiction opportunities, especially in the northeast quadrant of North Vietnam above Haiphong. Petroleum, oils, and lubricants (POL) were targeted for the first time as the fixed target focus was shifted to these resources midway through the year. Additionally, industrial and POL targets were struck for the first time inside the prohibited areas surrounding Hanoi and Haiphong.

As the bombing halt continued throughout the month of January, the aims of the air campaign over the North were reevaluated in a conference in Honolulu. While the overall objective of the campaign remained the same, reducing North Vietnam's capability to supply, support, and direct the communist insurgency in SEA, the lines of operation used to achieve this goal were modified from the ones used in 1965. These new tasks were to reduce and restrict external support to North Vietnam, to destroy in depth the resources in North Vietnam and to destroy all known military infrastructure, and finally to impede and disrupt the flow of men and material through the southern portion of North Vietnam on their way to Laos and South Vietnam.⁴⁰

The concept of operations called for a fixed number of sorties, with the individual efforts against these three tasks carefully balanced to place the maximum amount of

⁴⁰Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 24.

pressure on the enemy. Strangling outside support to the North required the continual disruption of the two rail arteries to Hanoi from China, as well as the port facilities at Haiphong, Hon Gay, and Cam Pha. Additionally several highway routes traced generally the same route as the rail lines. By targeting 15 key bridges along these LOCs, it was hoped that the flow of external support would be greatly reduced.⁴¹

In order to destroy the resources already in North Vietnam, POL storage, power plants, and remaining physical military infrastructure was to be targeted. Destruction of POL in particular was thought to have the ability to bring immediate and devastating effect on the flow of material to the South. While it did indeed complicate the transport problem for the North Vietnamese, the increased use of man portage of materials compensated.⁴² Destruction of the electrical power generation capacity in the North was also designed to complicate and reduce the enemy's ability to trans ship material from port facilities, and also to apply pressure to the government, as loss of electrical power would serve as a clear signal to the urban populations of the severity of American attacks.⁴³

The final task, that of interdiction of supply routes, was to be accomplished through armed reconnaissance sorties in order to disrupt and harass the logistical effort to the South. While this was seen as the least fruitful of the tasks, it was still a requirement

⁴¹Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 26.

⁴²*Ibid.*, 30.

⁴³*Ibid.*, 27.

to impede the enemy efforts. As such, there was an emphasis on keeping the number of armed reconnaissance sorties in check with respect to the two other tasks.

Meanwhile, Secretary of Defense Robert McNamara was defending Rolling Thunder in front of Congress. He stated that the bombing was achieving three objectives: “(1) Strengthening the South Vietnamese morale by showing our determination and continuing support; (2) reducing the flow of men and equipment from the North to the South and/or increasing the cost of that flow to the North Vietnamese by bombing infiltration routes and the military sources of supply; and (3) putting political pressure on North Vietnam to halt their subversion campaign in the South.”⁴⁴ He went on to say that, Rolling Thunder was never designed to break the will of the North Vietnamese, but that it was to “raise the political price of carrying on the campaign in the South.”⁴⁵ It was this admission, and the statement that the destruction of every bit of the North’s industrial capacity would not stop the flow to the South that served as a chilling commentary on the level of error by the Johnson administration in the assessment of the North’s commitment to the war.

On the last day of January, bombing resumed. Because of the halt of over 30 days, the efforts focused once again on clearing out the LOCs of men and material, and restriking the previously approved JCS targets. Seasonal monsoon weather affected operations, with the highlight being the bombing of Dien Bien Phu airfield in early February. Dien Bien Phu had been selected for primary political reasons, as the

⁴⁴Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 30.

⁴⁵*Ibid.*

communist regime valued it highly as a propaganda example of their victory over the imperialist French. It was hoped that the thorough destruction of this symbol would be a deep psychological blow to the North Vietnamese and serve as a public example of the American might.⁴⁶

On March 1st, a new version of the ROE went into effect. The area available for coastal-armed reconnaissance was greatly expanded, as well as the waterborne target set in order to interdict more in the marine environment. Any enemy unit that fired upon aircraft to or from the specified target could now also be attacked; furthermore, unexpended ordnance could now be dropped on approved Rolling Thunder targets instead of being dropped in approved jettison areas. These measures served to make the application of firepower more efficient. The use of reconnaissance aircraft was now also authorized before, during and after a strike. This was a change from the 1965 restrictions that only allowed for post-strike bomb damage assessment flights. While defensive MiG Combat Air Patrol and Iron Hand operations continued to be authorized, the airfields from which the enemy aircraft were operating from could not be attacked, and Iron Hand was not to be used in the target rich northeast quadrant near the Chinese border known as Route Package VI.

The JCS indicated that these changes were only the start of a more thorough overhaul of the ROE. He noted the inputs of allowing armed reconnaissance inside of Route Package VI to better interdict the northeast LOCs to China, and the proposed use

⁴⁶Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 36.

of B-52s to bomb low threat border areas such as Mu Gia Pass. Doing so would reduce the strain on tactical jet aircraft and free them for operations elsewhere.⁴⁷

On April 1st, CINCPAC issued an order that greatly restructured the areas of responsibility and coordination for the campaign in North Vietnam. The route packages were to be redistributed with the following responsibilities for photo reconnaissance and armed reconnaissance: COMUSMACV was to be responsible for Route Package I, the area bordering the DMZ in the southern portion of North Vietnam. The Commander in Chief, Pacific Fleet was assigned Route Packages II, III, IV, and IVB. This included central and the northeast coastal area of North Vietnam, to include all the major ports. The Commander in Chief, Pacific Fleet was assigned Route Packages V and VIA, which was the remainder of the country, essentially the northern three quarters of North Vietnam. Route 1A, a highway artery northeast of Hanoi was assigned joint responsibility between the Navy and the Air Force. Alpha targets, that is the preplanned JCS designated targets, were to be assigned irrespective of service or area. Furthermore, due to possible weather restrictions, the Air Force and the Navy were authorized to coordinate and operate in each other's assigned areas.⁴⁸

⁴⁷Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 38.

⁴⁸*Ibid.*, 42.



Figure 1. Route Package Organization

Source: U.S. Military Academy Atlas, “Vietnam and Vicinity,” <http://www.westpoint.edu/history/SiteAssets/SitePages/Vietnam%20War/af.gif> (accessed May 15, 2014).

Additionally, the full spectrum of mission capabilities was now authorized. Every type of attack and support mission was allowed. This served to bring the full weight of U.S. forces to bear with the maximum chance for success. Additional flexibility was granted by additional instructions governing Rolling Thunder operations. Specifically:

(1) optimum conventional weapons loads were to be used; (2) Additional thought was to be applied to the safety of forces and the use of appropriate tactics to conserve the force. The commander was allowed to gauge the maximum feasible damage that could be inflicted upon a target, thus weighing the cost benefit to commitment of additional forces against a target; (3) Legitimate military targets of opportunity were authorized for destruction; (4) Previously attacked JCS targets were authorized for additional attack by returning strike aircraft or armed reconnaissance aircraft. This was to continually destroy and degrade these targets, and to also inject an element of surprise into the campaign and (5) Coastal armed reconnaissance target sets were also expanded. These changes allowed for more flexibility in the application of U.S. air power, and were designed to allow attack of fleeting targets.⁴⁹

Still, there were restrictions that continued to hamper the full application of force: Populated areas were to be avoided. Virtually anything to do with the civil management of water or with the populace on the water was to be avoided such as locks and dams, hydro-electric power plants, sampans, houseboats and fishing boats. The Yen Phu and Vinh Army Barracks were also off limits. These targets could only be struck with specific permission from CINCPAC. More importantly, the restricted areas remained. Hanoi and Haiphong retained their protective veils of 30 nautical miles and 10 nautical miles respectively. A 30 nautical miles wide prohibited band also extended the entire width of North Vietnam along the border with China. Entry into these areas was only approved through specific authorization. U.S. fighters were allowed to pursue MiGs into these

⁴⁹Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 44.

prohibited zones, however they were not allowed to attack the airfields located within, nor were they allowed to come within 12 nautical miles of the Chinese border.

Additionally, electronic countermeasures were to be employed only when operationally necessary to avoid undue exposure of U.S. capabilities to North Vietnamese SAM and radar operators.⁵⁰

⁵⁰Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 46.

April saw the initiation of attacks against LOC chokepoints, with good effects noted of the attacks at the Ron and Quang Khe ferry crossings. By attacking the approaches and seeding the area with time-delayed bombs, a large contingent of enemy rolling stock had backed up behind the crossing, allowing for its destruction in depth. In addition, the attacks near the port of Cam Pha had caused third party shipping to be diverted. With these evident successes, further pressure on LOC chokepoints and coastal interdiction was directed.⁵¹

The first use of B-52s in North Vietnam occurred on April 11th, with 30 B-52s dropping nearly 1,400 750-pound and 1,000-pound bombs on Mu Gia Pass. In a feat of human labor, post-strike photography showed that all the craters had been filled little more than 24 hours after the strike, with tire tracks evident over the filled soil.⁵² This was an indicator of the will of the North Vietnamese effort, but was incorrectly interpreted in official reports.

The first industrial target of 1966 was proposed in May. COMUSMACV suggested that the Thai Nguyen Iron and Steel Complex be struck in retaliation for a recent Viet Cong bombing of a cement plant in South Vietnam. The Thai Nguyen Iron and Steel complex was an economic asset vital to the North's ability to repair and construct LOC infrastructure and was designed to provide 20 percent of North Vietnam's domestic iron and steel requirements. Debate ensued, and as a result, the campaign against the POL infrastructure was begun on June 29, 1966 instead. The ROE were again

⁵¹Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 50.

⁵²*Ibid.*

loosened in order to attack distributed stocks of POL along LOCs in restricted areas, and along the coast and at port facilities.⁵³

It was estimated by the Defense Intelligence Agency that the POL storage capacity of North Vietnam was 179,000 metric tons. Due to imports during 1965, it was also estimated that the system was at full capacity. It was further estimated that 32,000 metric tons was the annual requirement for North Vietnamese operations. In anticipation of these attacks, the North Vietnamese had begun to distribute supplies of POL in 1965.⁵⁴ This did not go unnoticed, and so the decision was made to strike these reserves while still consolidated and therefore more vulnerable to attack. It was also believed that the destruction of enemy POL would have immediate damaging effects on the throughput of supplies to the south, and the trans loading of supplies in the port areas and rail yards.

The POL supplies had been politically sensitive due to the location of the bulk storage facilities. Some 106,000 metric tons was located in the Hanoi and Haiphong restricted areas. Nevertheless, in mid-June authorization was given to strike these targets with special consideration and preparation being paid to their political sensitivity. In a coordinated effort starting on June 29th, Air Force and Navy aircraft struck bulk POL storage facilities in multiple locations across North Vietnam, destroying two-thirds of the enemy stockpile in three days.⁵⁵

⁵³Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 54.

⁵⁴Smith, *Rolling Thunder*, 96.

⁵⁵Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 64.

At a mid-year conference attended by Secretary of Defense McNamara, Admiral Sharp reiterated to the JCS that there was evidence that the air campaign fielded during the first half of 1966 was not effectively stunting the flow of men and equipment to the South. This evidence showed an increase in the number of North Vietnamese Army (NVA) maneuver battalions to the South, and he forecasted the need for additional U.S. ground forces to deal with them. In order to prevent an increase in magnitude of the ground war in the South, more effective measures must be used to interdict in the North. He also stated that the plan spelled out in January had not been enacted in its full design. Specifically, no measures had been taken to restrict foreign imports through port facilities, especially Haiphong, and that the most effective way to affect the flow of arms to the south was to stop it at the source. Additionally, only in late June had the resources already in place been struck, specifically the POL storage areas and training facilities in the northeast. Without the full implementation of the plan, effective results could not be expected.⁵⁶

As a result, a plan was birthed that was to bring about the maximum destruction of POL. Four requirements existed for effective action:

1. Destruction of the means by which POL was imported into [North Vietnam]NVN.
2. Destruction of known fixed POL installations.
3. Destruction of transitory targets.

⁵⁶Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 69.

4. A reconnaissance program to develop information on the overall POL system.⁵⁷

It was well known that the majority of POL entering North Vietnam was via oil tankers, primarily through Haiphong. With 72,000 metric tons of storage capacity, it was the juiciest POL target in North Vietnam.⁵⁸ While the capacity of fixed POL sites in above ground tanks was known, what was more difficult to determine was the amount in distributed sites, in 55-five gallon drums and in below ground storage tanks along LOCs. As summer turned to fall, new distributed storage sites were being discovered at a rate that essentially replaced the losses from attacking the above ground tanks.⁵⁹ Unseasonably poor weather also hampered interdiction efforts in Route Packages V and VI, thus reducing the previous pressure that had been applied with 81 percent of sorties being cancelled or diverted elsewhere.⁶⁰

Throughout the fall, Admiral Sharp continued to petition for authorization to strike the remaining 15 known POL sites, the Thai Nguyen Iron and Steel complex, and the Haiphong Thermal Power Plant. The POL sites to complete the destruction of known above ground storage, with the fringe benefit of denying North Vietnamese MiGs fuel for operations, the steel works to reduce the enemy's ability to manufacture replacement underground storage tanks and transportation infrastructure such as bridge girders, and

⁵⁷Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 73.

⁵⁸Smith, *Rolling Thunder*, 96.

⁵⁹Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 79.

⁶⁰*Ibid.*, 79.

the power plant so as to further complicate the offloading and shipment of supplies in the Haiphong area. Knowing that the weather had actually caused a release of pressure on the North Vietnamese, and that potentially another bombing halt was around the corner, he reiterated once again the need for the full application of the strategy for Rolling Thunder.⁶¹

This paid off and the JCS authorized an additional thirteen targets for Rolling Thunder 52, which began on November 12th. Unfortunately, the weather did not cooperate and so only two of these targets were struck in the remainder of the month. The year was capped off with two strikes in December that caused an international outrage due to North Vietnamese claims that over 100 civilians were killed when a residential area in Hanoi was allegedly intentionally bombed. Though the enemy had increasingly placed military targets in civilian areas, and such losses could be expected, the incident only served as a propaganda coup to the North Vietnamese.⁶² Additionally, four total days of bombing halt over Christmas and the New Year only served to allow the North Vietnamese to resupply, repair, and rearm their positions. While not the month long halt ordered a year previously, it still failed at the hope of diplomacy from the Johnson administration.

The end of year assessments showed that while thousands of vehicles were destroyed, the flow from the North had actually increased. The enemy's ability to adapt to losses and procure alternate means of conveyance such as pack animals and human

⁶¹Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 82.

⁶²*Ibid.*, 101.

portage allowed them to overcome any effects the interdiction efforts were making against vehicles. They were also quickly repairing damaged infrastructure or establishing bypasses to keep the supplies and men flowing to the South. The POL campaign had only caused them to rapidly disperse the remaining POL and to import more POL from external sources. Furthermore, there remained sufficient reserves for several years of operation. Additionally, the North Vietnamese had further advanced both the quality and quantity of their air defense system.⁶³ This was evident by the increase of air losses in 1966 to 280 from 163 the year before.⁶⁴ The effect of less than full implementation of the strategy for Rolling Thunder laid out by Admiral Sharp in January had only served to worsen the situation, both for the South and for U.S. airmen in the North.

Rolling Thunder, 1967

The assessment of Rolling Thunder operations in 1966 showed that the enemy possessed a tremendous ability to repair and recover from damage to its LOCs. It's adaptation of human portage to disperse and overcome shortages of rolling stock countered the increasing efforts of armed reconnaissance; which was the only portion of the three pronged Rolling Thunder concept of operations that had been fully utilized in 1966. While the POL campaign had caused the loss of great stockpiles of fuel and resources, the failure to complete the destruction in detail had left the North with sufficient reserves, though they were now distributed. Additionally, failure to strike industrial targets left the North with the capability to manufacture repair parts for bridges,

⁶³Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER July 1965-December 1966*, 128.

⁶⁴Smith, *Rolling Thunder*, 148.

and with electrical power. The poor weather had played a large part in limiting the continued destruction of infrastructure in the fall, primarily due to the lack of all-weather precision bombing capability in the U.S. Air Force, and limited numbers of A-6 Intruder aircraft in the Navy and Marine Corps, which were the only tactical aircraft in the U.S. inventory at this time that truly had an all-weather precision attack capability.

In December of 1966, the RAND Corporation, a Washington, DC think tank, published its report on the effectiveness of the Rolling Thunder operation to date. It was primarily focused on answering the questions of how effective the operation was at influencing “The physical and organizational functioning of North Vietnam as an economic and political entity; and its ‘coercive’ effects, or its efficacy in reducing the Hanoi government to agree to negotiations, on initial terms acceptable to the U.S.”⁶⁵ These were the indirect and direct effects that Secretary of Defense McNamara had listed as the potential fruit of the Rolling Thunder campaign in 1965. The report stated that due to the bombing huge manpower resources were diverted from nonmilitary activities such as food production, to repairing infrastructure and to defense of infrastructure. Thus, there was a definite strain on food supply, especially in urban areas. However, it went on to say that overall, the bombing had served as a rallying cry for the communist regime, and that “There was no evidence at present that, economically and politically, Hanoi should not be able to withstand the long, hard war it professes to have in mind.”⁶⁶

In examination of the campaign’s application, the report detailed that the main constraints on air operations were: “(1) Keeping civilian casualties to a minimum; (2)

⁶⁵Smith, *Rolling Thunder*, 133.

⁶⁶Ibid.

limiting attacks to ‘military objectives;’ and (3) avoiding any actions which might provoke China or the USSR into more direct involvement.”⁶⁷ It then proposed that the “U.S. failure to date to undertake a maximum effort to deny access to imports by sea and over land--attributable evidently, mainly to the fear of provoking and activating the USSR and China--thus emerges as the outstanding gap in the logic of U.S. coercive strategy against North Vietnam.”⁶⁸ The report concluded by saying that even if escalated in tempo, with the current restrictions in place there was no indication that Rolling Thunder would bring about the desired outcome “within an acceptable period of time.”⁶⁹

Accordingly, the suggestion by CINCPAC for 1967 operations again was for full implementation of the original concept of operations for Rolling Thunder. Noted were the observed psychological reactions by the North in response to attacks in the Hanoi area in December of 1966. It was predicted that additional attacks against lucrative targets in the prohibited areas, specifically Hanoi, Haiphong, and the northeast portion of the country would bring similar reactions. Additionally they would be plainly evident to the populace. The closure of Haiphong was again pressed for, as well as the destruction of “hard to repair targets” such as port unloading machinery, power plants, aircraft maintenance facilities and the country’s only steel works at Thai Nguyen.⁷⁰

COMUSMACV also pressed for additional leverage, “While 1966 was a year basically characterized by holding actions and spoiling attacks, 1967 must be a year of general

⁶⁷Smith, *Rolling Thunder*, 134.

⁶⁸Ibid.

⁶⁹Ibid.

⁷⁰Ibid., 129.

offensives by which we increase the momentum of our success.”⁷¹ In response, the force wielded by Rolling Thunder was increased by additional targets, many of them near or in restricted or prohibited zones, additional sorties, and new and improved aircraft and weapons.⁷²

The weather was once again poor during the first quarter of 1967 due to the seasonal northeast monsoon flow. This allowed for use of A-6A Intruder aircraft by the Navy and additional sorties provided by the USMC to prove their worth.⁷³ The Air Force was still without a true precision all weather bombing capability, but was experimenting with MSQ-77 ground based radar⁷⁴ and also with the ground mapping radar aboard the F-105F Thunderchief and with pathfinder aircraft such as the B-57 Canberra and B-66 Destroyer. This also caused the accelerated deployment of the F-4D variant to theater since it offered an all-weather capability. A true all weather, day or night attack tactical capability for the Air Force would not be seen until 1968 in the form of the F-111 Aardvark, too late to play a meaningful part in Rolling Thunder.⁷⁵ Nevertheless, 12 of the 16 new targets authorized under Rolling Thunder 52 through 54 were struck by the end of March. These included the thermal power plants at Viet Tri and Thai Nguyen, and more

⁷¹HQ USMACV, *Official MACV Command History, 1967*, 399.

⁷²Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER January 1967-November 1968*, 4.

⁷³Headquarters Pacific Air Force, *Project CHECO Report: The War in Vietnam: January-June 1967* (Washington, DC: Government Printing Office, 1968), 87.

⁷⁴*Ibid.*, 88.

⁷⁵*Ibid.*, 21.

importantly the Thai Nguyen Iron and Steel Works.⁷⁶ The Thai Nguyen Iron and Steel Works had been a requested target since 1965. This was a particularly critical target now in light of the fact that it was the North's only indigenous manufacturing capability for replacement bridge girders and for pontoons used to build river bypasses. By the end of April, it was to be knocked completely out of action for an estimated 12 to 18 months, having been struck 11 times.

As the weather improved in the spring, attention was shifted to the lucrative areas in the northeast consisting of mostly Route Package VI. In five weeks, more destruction was achieved in this region than in all the previous Rolling Thunder operations combined.⁷⁷ Additionally the rail network in North Vietnam was pounded, with the main arteries from China being rendered inoperative for weeks at a time. Still more strikes on power plants resulted in 85 percent of North Vietnam's prewar electricity generation capability to be destroyed by July.⁷⁸ July also showed perhaps the first signs of complete mobilization of the North Vietnamese populace as some LOC's went weeks without signs of repairs. This was further reinforced by a COMUSMACV report that stated that in addition to the destruction of 85 percent of the electrical capacity, the North had lost its entire steel and cement production capacity, 30 percent of the railway system destroyed, 50 percent of the railway repair capability, and the loss of 50 percent of their air force, with 500,000 people mobilized in repair of infrastructure. A more telling fact was that

⁷⁶Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER January 1967-November 1968*, 6.

⁷⁷HQ USMACV, *Official MACV Command History, 1967*, 430.

⁷⁸Headquarters Pacific Air Force, *Project CHECO Report: ROLLING THUNDER January 1967-November 1968*, 7.

flour had been introduced in some areas instead of rice, which shed light on the food shortages that were now becoming commonplace in urban areas.⁷⁹

July also brought about another change in ROE. In another reduction in restrictions, the restricted/prohibited areas around Hanoi and Haiphong were changed to 30 nautical miles/10 nautical miles and 10 nautical miles/four nautical miles respectively. The buffer zone along the Chinese border remained, but targets could now be struck within it.⁸⁰ In addition, fighter aircraft in pursuit were now allowed to attack the airfields at Hao Lac, Kep, Kien An, and Kep Ha airfields. Armed reconnaissance was now also allowed to strike targets within the restricted zone of Hanoi.⁸¹ Strike pressure was kept up in August with the United States scoring a major propaganda coup with the dropping of the Paul Doumer bridge in Hanoi on the 11th. This was to be another readily evident example of the U.S. pressure to the North Vietnamese urban populace.⁸²

Beginning in August, and in full swing by September, was the attempted isolation of Haiphong. The main port of entry to North Vietnam, Haiphong had never been fully interdicted during Rolling Thunder due to worries of provocation of the Union of Soviet Socialist Republics and China, due to their shipping along the docks and harbor. A plan was devised to create an interdiction ring around the port, targeting key bridges, and building off the success of the river and estuary mining that was began in May. By the

⁷⁹HQ USMACV, *Official MACV Command History, 1967*, 431.

⁸⁰Headquarters Pacific Air Force, *Project CHECO Report: The War in Vietnam: July-December 1967*, 87.

⁸¹HQ USMACV, *Official MACV Command History, 1967*, 435.

⁸²*Ibid.*, 436.

end of September, all four major bridges out of Haiphong had been struck, reducing the output from the port to the surrounding countryside from an estimated 3,800 short tons per day to 1,900, a 50 percent reduction. To compensate, the North began moving supplies along the coastal waterways.⁸³ In response, a major mining effort was launched in October by all the services to counteract this flow of supplies to the South.

Also in October was the culmination of a series of strikes against jet capable airfields in North Vietnam with a strike on the main military base at Phuc Yen. Located inside the Hanoi prohibited zone, with its own POL source, this base was estimated to house 20 of the 27 remaining MiG-21 Fishbed fighters in North Vietnam.⁸⁴ Again, due to political considerations, this critical defense infrastructure had never been struck. However, with the introduction of the AGM-62 Walleye glide bomb, there now existed a precise method by which to strike it and not risk civilian casualties. Previous successful uses at the Paul Doumer and Thanh Hoa bridges had demonstrated its exceptional accuracy, though at Thanh Hoa its 1,000-pound bomb body had not been sufficient to bring down the behemoth.⁸⁵

Beginning on October 24th, Phuc Yen was struck over a period of two days, destroying several MiGs on the ground and the control tower via a direct hit with a

⁸³Headquarters, Pacific Air Force, *Project CHECO Report: ROLLING THUNDER January 1967-November 1968*, 10.

⁸⁴Headquarters, Pacific Air Force, *Project CHECO Report: The War in Vietnam: July-December 1967* (Washington, DC: Government Printing Office, 1968), 7.

⁸⁵Headquarters, Pacific Air Force, *Project CHECO Report: The War in Vietnam: January-June 1967*, 106.

Walleye.⁸⁶ This left the international airport at Gia Lam in Hanoi as the only jet capable airfield not yet struck by the United States in the whole of North Vietnam. While runway craters were to be expected to be repaired somewhat expeditiously, the support equipment, and facilities destroyed were more difficult to replace.⁸⁷

Additionally in early November, the third change to the ROE was delivered, the highlights being the Chinese buffer zone being reduced to 20 nautical miles; in addition, aircraft in pursuit were now allowed into all restricted and prohibited airspace, to include the entirety of the Chinese buffer zone, though not into the territorial airspace of China. Furthermore, aircraft could now attack the airfields from which the enemy aircraft were suspected to be operating from, as long as they had been previously struck.⁸⁸ In light of the attacks on Phuc Yen and the Cat Bi airfields near Haiphong in October, this only left Gia Lam as a sanctuary airbase. The overall effort against the North Vietnamese air force in 1967 was to force large numbers of the remaining aircraft into southern China for sanctuary.⁸⁹ The remaining two months of 1967 saw seasonal poor weather move in, with some isolated strikes against repair efforts of bridges in the Hanoi area.

Overall, 1967 was to be the peak year of Rolling Thunder activity. The first quarter of 1968 only saw four days of clear weather, which was followed by an unplanned bombing halt by President Johnson in March following the Tet Offensive in February. The year 1967 demonstrated the potential of Rolling Thunder, with tremendous

⁸⁶HQ USMACV, *Official MACV Command History, 1967*, 460.

⁸⁷*Ibid.*, 437.

⁸⁸*Ibid.*

⁸⁹Smith, *Rolling Thunder*, 145.

destruction being brought upon the limited industrial base of North Vietnam and its supply system. However, the full extent of Rolling Thunder's power was never brought to bear out of fear of the Union of Soviet Socialist Republics and China entering the conflict. Specifically the failure to completely close the port of Haiphong allowed the North Vietnamese to overcome the hardships levied upon them by simply importing more weapons, munitions, finished goods, and foodstuffs. Without closure of this key center of gravity, all the other successes were for naught. The cost of this failure at the operational level of war was 321 U.S. aircraft; the highest annual total during the whole of Rolling Thunder.

CHAPTER 4

MEASURE AND COUNTERMEASURE

Americans do not like long, inconclusive wars . . . thus we are sure to win in the end.

— Pham Van Dong, in Jon Van Dyke,
North Vietnam's Strategy for Survival

A View from the North

In order to understand the successes of the North Vietnamese, one must understand their psychological makeup. The entry of U.S. airpower in 1964 was but only the beginning of the next chapter of their struggle for independence that was over 100 years old. First, the Chinese, then the French, with a brief intermission against the Japanese in World War II, had conditioned and hardened the populace to a life of constant war and struggle. The application of strategic bombing to their country was just another obstacle to overcome. When a country is being attacked at home, by foreigners, it has the inherent advantage of the defense. While this advantage was more intense in the land battles in the South, it still played a part to solidify and mobilize the entire populace of North Vietnam to resist and persevere.

This long war strategy was borne from the fact that the majority of the Politburo members had been at war themselves for over 40 years, thus this was the only way of war they knew. Conversely, the American way of war, one of firepower and technology, abhorrent of casualties and dedicated to a quick victory was the antithesis of this.⁹⁰

⁹⁰Jon M. Van Dyke, *North Vietnam's Strategy for Survival* (Palo Alto, CA: Pacific Books, 1972), 30.

Knowing this, the North Vietnamese Prime Minister, Pham Van Dong said, “Americans do not like long, inconclusive wars . . . thus we are sure to win in the end.” He also realized that the only way to defeat the Americans was to outlast them.⁹¹

In the face of the aerial destruction wrought by the Americans, the North Vietnamese mobilized the entire populace. Indeed, even before the first strikes of Rolling Thunder in March 1965, the government had already begun to evacuate the cities and had begun a plan of distributing resources to make them harder to strike.⁹² Militarily, the Air Defense Air Force Service Branch of the North Vietnamese Armed Forces had been placed on a wartime status even before the Tonkin Gulf Incident in August of 1964. This brought about the mobilization and formation of large numbers of militia air defense cells. While some were equipped with 12.7 millimeter machine guns, all were at least equipped with rifles.⁹³ In fact, by the end of July 1964, the entirety of the North Vietnamese armed forces had been put on wartime footing.

The civilian populace was told to expect the destruction of all cities in Vietnam. The psychological conditioning needed to resist the air attacks was well underway even before they began in earnest. Every citizen was assigned duties to bring him into the war effort and make him feel a part of it. Every adult was issued a rifle and told it was his duty to shoot at American planes with it. This was not unnoticed by U.S. pilots who called this practice the “Hanoi Habit” as “even waitresses would run outside and start

⁹¹Van Dyke, 31.

⁹²Ibid., 30.

⁹³Merle L. Pribbenow, *Victory in Vietnam: The Official History of the People's Army of Vietnam, 1954-1975* (Lawrence: University Press of Kansas, 2002), 128.

firing when the sirens sounded, using weapons from 7.62 rifles to WWII Browning M-2 .50 caliber machine gun.”⁹⁴ Additionally, every citizen was told it was his duty to capture downed pilots, to assist and if need be replace anti-aircraft gunners, be on the lookout for commandos and spies from the South, to prepare fortifications and battle plans to protect against an invasion, and to keep the LOCs and transportation flowing to the South to support the war effort there.⁹⁵

The air defense system in place in July 1964 across North Vietnam was rudimentary and aged by the contemporary standards of the time. In fact, it was roughly equivalent to what United Nations forces had found in Korea in 1950. In many ways, it was actually worse, having no fighter aircraft force in position, and only a small amount of antiquated small and medium caliber AAA and automatic weapons (AW) with an engagement envelope of only 5,000 feet above ground level. Only a tiny fraction of which was radar guided with only four fire control radars existing in the country.⁹⁶ Had the full fury of Rolling Thunder been unleashed in the first six months of 1965, before the SA-2 became operational, the strike forces would have only had to face this defense system with the addition of the MiG-15 and MiG-17 fighters of the fledgling North Vietnamese air force. Instead, the tactic of measured escalation allowed the North to quickly grow and add to the sophistication of its air defense system. By the end of

⁹⁴Headquarters Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses December 1966-1 November 1968* (Washington, DC: Government Printing Office, 1969), 2.

⁹⁵Van Dyke, 80.

⁹⁶Headquarters Pacific Air Force, *Project CHECO Report: Tactical Electronic Warfare Operations in SEA, 1962-1968* (Washington, DC: Government Printing Office, 1969), 15.

Rolling Thunder in 1968, it was estimated that it possessed 8,050 AAA guns of all calibers, 32 MiG-21s and 15 MiG-15/17s in country, with another 108 in southern China. The North Vietnamese also fielded 35-40 SA-2 Battalions, with six missile launchers each and the requisite complement of Fan Song tracking radars. Additionally, 400 radars of various types and functions were spread across the country. By the middle of 1968, the airspace above North Vietnam was recognized as perhaps “one of the most complex electromagnetic defense threats ever to be combatted by USAF tactical forces.”⁹⁷

The period of being able to ingress North Vietnam at medium altitude, and only face visually directed AAA and Automatic Weapons in the final 3,000 feet of roll in on a target only lasted four months. On July 24, 1965, a U.S. Air Force F-4C was the North’s first victim of the SA-2 Guideline (North Atlantic Treaty Organization nickname) SAM.⁹⁸ Although the SA-2 had been known about by U.S. forces since 1958, the nuclear minded U.S. Air Force had only considered it a threat to strategic bombers. As such, an onboard jamming capability had been developed for the B-52 Stratofortress, the main strategic bomber of the United States. The Tactical Air Command of the U.S. Air Force had not foreseen the use of tactical aircraft in a strategic bombing role. Thus, U.S. Air Force tactical aircraft found themselves vulnerable to radar guided SAMs. The U.S. Navy on the other hand, having no strategic bombers, did have some protection for their tactical

⁹⁷Headquarters Pacific Air Force, *Project CHECO Report: Tactical Electronic Warfare Operations in SEA, 1962-1968*, 16.

⁹⁸*Ibid.*, 15.

aircraft.⁹⁹ Nevertheless, in the first round of Rolling Thunder, the North Vietnamese had seized the initiative.

The S-75 surface to air missile was one of the first fielded by the Soviets and certainly one of the first widely exported. Given the North Atlantic Treaty Organization designation SA-2 Guideline, many variants remain in use today throughout the world. In 1961, it famously downed the U-2 flown by Francis Gary Powers over the Soviet Union. Made to strike highflying, lumbering strategic bombers, it was massive in size. Most pilots described it as a flying telephone pole. With a large warhead and supersonic speed, it was still very deadly to tactical aircraft flying in predictable formations at medium altitudes between 15,000 and 20,000 feet. In fact, it was capable of prosecuting targets from 1,500 feet to above 60,000 feet. Each battalion in North Vietnam consisted of six launchers, and one Fan Song tracking radar. The advantage of the Fan Song lay in its two beams, one each in azimuth and elevation that allowed it to track one target while scanning for another. With a range of nearly 20 nautical miles, it provided a long-range capability for its day.

In April of 1965, Ho Chi Minh enacted the wartime military service law. All current members of the armed forces would be held on active duty until the cessation of hostilities. All previously discharged or retired officers and enlisted men were recalled to active service.¹⁰⁰ The air defense system of North Vietnam experienced explosive growth during the remainder of 1965. AAA forces grew from 12 regiments and 14 battalions to

⁹⁹Headquarters Pacific Air Force, *Project CHECO Report: Tactical Electronic Warfare Operations in SEA, 1962-1968*, 18.

¹⁰⁰Pribbenow, 164.

21 regiments and 41 battalions, including eight mobile battalions. Two full regiments of SA-2s were formed, after extensive training in the Soviet Union. The air force grew from one regiment of MiG-15/17 aircraft to three regiments, additionally introducing the supersonic MiG-21 Fishbed into the inventory. Finally, the radar force doubled in size from two regiments to four.¹⁰¹ What had taken seven years to assemble in the satellite nations of the Soviet bloc had taken just seven months in North Vietnam.¹⁰²

The long ceasefire over Christmas of 1965 and January of 1966 allowed the North Vietnamese to gain further momentum. Air defenses spread from the urban centers of Hanoi and Haiphong south to Thanh Hoa and to Ha Tinh. Fighter inventory was increased to an estimated 125 aircraft with crates containing freshly manufactured Soviet MiGs being imported daily. The SAM network was increased by one-third in just 30 days, and heavy concentrations of new AAA were spread along the vulnerable LOCs. Furthermore, the overall command and control network was coalescing, having gained valuable experience and training against the strikes of 1965.¹⁰³ This was evidenced by the first night intercept of a U.S. Marine Corps F-4B flight by MiG-17s on the night of February 3rd, 1966. Later that same month, an RB-66C Destroyer, an aircraft specifically modified to detect and jam the SA-2, was shot down. The entire detect to engage sequence took 21 minutes, with the RB-66C employing both chaff and high power jamming to defeat the SA-2. Skillful detection by multiple radars, the use of frequency

¹⁰¹Pribbenow, 165.

¹⁰²Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses: August 1964-November 1966* (Washington, DC: Government Printing Office, 1967), 26.

¹⁰³*Ibid.*, 25.

agility, and delayed target engagement by the North Vietnamese was used to defeat the countermeasures employed by the RB-66C while reducing the time the SAM site was actually vulnerable to detection and thus possible destruction.¹⁰⁴ This demonstration of emissions control was a marker of the high proficiency of the North Vietnamese operators. Additionally, this tactic reduces the opportunity for a Radar Warning Receiver to detect and provide warning to an attacking pilot. In a tactical aircraft with one or possibly two crewmembers, with detection and countermeasure equipment inferior to the RB-66C, the only chance of defeating the SA-2 became visual acquisition of the missile after firing, and then violent maneuvers to defeat the missile guidance itself. This could be especially difficult during the monsoon season, when cloud cover could hide the missiles in flight, reducing the reaction time available to the pilot.

By August of 1966, the North had a sophisticated and redundant air defense system consisting of 65 fighter aircraft, an estimated 25 battalions of SA-2s, 271 radars, and 4,400 pieces of AAA.¹⁰⁵ Additionally, it began a fourfold increase in the quantity of light AAA guns, those under 57 millimeters, to concentrate the lethality of their Integrated Air Defense System (IADS) below 13,000 feet.¹⁰⁶ The United States made a concerted effort to regain the initiative from the North Vietnamese with the introduction of the QRC-160 jamming pod in September of 1966. While testing showed dominating

¹⁰⁴Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses: August 1964-November 1966*, 28.

¹⁰⁵*Ibid.*, 44.

¹⁰⁶Headquarters, Pacific Air Force, *Project CHECO Report: The War in Vietnam: January-June 1967*, 115.

results, the scarcity of pods available kept it from becoming a deciding factor.¹⁰⁷ The adaptability of the North Vietnamese again was shown in response to the introduction of the pod. In November, they demonstrated their first use of SAMbush tactics. Using a MiG as bait, U.S. fighters were lured into a field of overlapping engagement circles from multiple SA-2 sites. Once in the heart of the engagement envelope, six missiles were fired at them, followed by an attack by a separate flight of four MiG fighters. While no U.S. aircraft were lost, the level of sophistication by the North Vietnamese attack could not be understated.¹⁰⁸ The introduction of Soviet Identification Friend or Foe in March of 1965 to the MiG force had allowed the North Vietnamese to construct the Joint Engagement Zone required for this level of tactical operation.¹⁰⁹ December 1966 marked the first successful use of an AA-2 Atoll heat-seeking missile by a MiG, as well as the sheer bulk and quality of the AAA being increased by revetting and reinforcing established sites, while still building more sites to improve mobility. Still very much retaining the initiative, the first use of barrage SAM tactics were displayed in December 1966 to further overcome the use of self-protection jamming pods. The ongoing proliferation of SA-2 sites also forced back the protective orbits of standoff jammers such as the EB-66C and EKA-3B, greatly reducing their jamming effectiveness. This resulted

¹⁰⁷ Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses December 1966-1 November 1968*, 3.

¹⁰⁸ *Ibid.*, 2.

¹⁰⁹ Headquarters Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses: August 1964-November 1966*, 44.

in the highest losses to the SA-2 for the entire year.¹¹⁰ The United States admitted to the stiff resistance that year in the Rolling Thunder Digest, concluding, “the best testimonial to the effectiveness of Rolling Thunder is the monumental effort Hanoi is making to stop it.”¹¹¹

Finally, in the spring of 1967 enough QRC-160 pods became available to at least partially wrest the middle altitudes back from the SA-2. Nonetheless, the MiG forces compensated and attacked in strength, causing record U.S. losses in April, as well as record SA-2 firings. Furthermore, the tactical formations required for efficient coverage from the QRC-160 caused only the lead aircraft’s bombing to be accurate.¹¹² By the end of 1967, after what was seemingly a reduction in the trend of U.S. air losses, November brought the single largest monthly loss of U.S. aircraft to date in Rolling Thunder. Statistics showed that the introduction of the QRC-160 showed little improvement against the North’s IADS.¹¹³

Massive imports of Soviet Bloc material and weapons plus the full mobilization of the populace enabled the North Vietnamese were able to build an interlocking system of air defense. Combining the virtues of every component created a system greater than the sum of its parts. The SA-2 by itself would have been an inconvenience to American pilots, as the totals for Rolling Thunder prove. Only 20 percent of U.S. losses were

¹¹⁰Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses December 1966-1 November 1968*, 3.

¹¹¹*Ibid.*, 4.

¹¹²*Ibid.*, 17.

¹¹³*Ibid.*, 21.

attributable to it in 1967.¹¹⁴ The AAA and automatic weapons by themselves would not have been insurmountable-the aircraft would have simply flown over it. The MiGs by themselves had no real capability to hunt U.S. aircraft by themselves and in the cloudy skies of North Vietnam, visual detection was difficult. The Early Warning (EW)/and Ground Control Intercept (GCI) radars have no destructive capability and therefore are harmless by themselves. However, when placed together in a system integrated through redundant communications nodes, the combination became deadly. Furthermore, there was no center of gravity to target. Each component became a force multiplier for the other. The EW/GCI radars detected the inbound strike package at long range. MiGs were vectored to perform slashing, high-speed hit and run tactics, with just their appearance causing many strike aircraft to jettison their bombs in anticipation of evasive maneuvering. SAM target tracking radars then were cued to the invaders. Salvos of missiles were launched into the air. More bomb loads were jettisoned as aircraft performed high G jinking maneuvers designed to defeat the SA-2's guidance system. These maneuvers caused the attacking aircraft to trade altitude in exchange for the airspeed vitally needed to continue the maneuver. The SA-2 defeated, the aircraft now found itself in the deadly engagement envelope of the AAA units-everything from 100mm radar directed cannon fire to the waitress shooting her 7.62 millimeter rifle at the aircraft. It was in this meat grinder so thoroughly designed by the North Vietnamese that in 1967, the most active period of Rolling Thunder, nearly 55 percent of losses were directly attributable to AAA, with another nine percent to AW. Further still, an additional

¹¹⁴ Author's calculated total.

eight percent were lost to MiGs.¹¹⁵ Not directly assessable are the tons of bombs that were prematurely jettisoned over the North Vietnamese countryside by American pilots in order to avoid death. These losses were quickly and easily turned into propaganda coups that served to continually encourage the North Vietnamese population. Thus, the will to fight was continually refreshed.

The Americans Struggle to Recapture the Initiative

The American tactical experience in Rolling Thunder was characterized by a failure to exploit the initiative gained from the Flaming Dart attacks, and by a struggle to regain the initiative from the North Vietnamese after the introduction of the SA-2 in July 1965. This struggle was to endure through the end of Rolling Thunder in 1968 as the Americans floundered against the rapidly constructed and formidable North Vietnamese IADS. Had the initiative been exploited, even in the five-month period from the start of Rolling Thunder to the introduction of the SA-2, the majority of Rolling Thunder objectives could have been attained in that short period.

The policy of controlled escalation squandered this opportunity. American airpower at the time, had it been applied with Clausewitzian principles of massive and violent attack, might have truly brought about a rapid change in the North's policy toward the South. Instead, tactical naval aircraft were used in a limited fashion, in order to achieve strategic goals. Had Strategic Air Command B-52s been used to immediately crush Vietnamese infrastructure, they would have enjoyed near impunity in the first few months. Indeed, B-52s were part of a plan to counter the MiG threat that had become a

¹¹⁵ Author's calculated total.

reality in the spring of 1965.¹¹⁶ However, U.S. foreign policy concerns overrode this approach and once the SA-2 appeared in July of 1965, this window of opportunity was closed for the remainder of the war. With the exceptions of the use of the B-52 to bomb low threat border areas in an interdiction role, the Stratofortress would not be used against high threat targets in North Vietnam until Linebacker II in December of 1972. These last missions of the war over the North would be fated for disaster.

The U.S. force structure in 1965 was a product of many years of the Cold War. Virtually every aircraft in the inventory was either designed to deliver a nuclear weapon or support those that did. Additionally, the U.S. fighter force was designed for fast, high altitude intercept of Soviet bombers. Subsequently they had flying qualities and weapons commensurate for this task: high rate of climb, supersonic speeds, and large radar guided air-to-air missiles. The newest U.S. fighters such as the F-4 Phantom II had been built without a gun—a weapon deemed not necessary for downing high flying Soviet bombers. These attributes would prove to be a handicap, not a help, in the skies over North Vietnam against highly maneuverable MiG-15 and MiG-17 aircraft, made for the traditional dogfight in the visual arena. While the intercept mission U.S. fighters were designed for was a clear cut case of enemy aggression which simplified identification, the ROE in Vietnam required visual identification of the MiGs before they could be shot down. This relinquished the inherent advantage of the F-4, its airborne radar and AIM-7 Sparrow missiles; both designed for killing at beyond visual range.¹¹⁷ Once in the visual

¹¹⁶Headquarters, Pacific Air Force, *Project CHECO Report: ROLLING THUNDER* (Washington, DC: Government Printing Office, March 1966), 58.

¹¹⁷Jeffrey L. Levinson, *Alpha Strike Vietnam: The Navy's Air War 1964-1973* (Novato, CA: Presidio Press, 1989), 47.

arena, the minimum range of the Sparrow was quickly reached, and the only weapon remaining was the AIM-9 Sidewinder. With a limited number onboard, and with suspect reliability due to the damp climate, the U.S. pilot flying an aircraft without a gun found himself at a distinct disadvantage. Furthermore, lack of training on the fundamentals of air combat led to many pilots not understanding how to “fight” their high performance jets against the more maneuverable MiGs.¹¹⁸

The U.S. Air Force found itself primarily with the Century series of aircraft; specifically the F-100 Super Sabre, the RF-101 Voodoo, the F-102 Delta Dart, the F-104 Starfighter and the F-105 Thunderchief. These aircraft were vestiges of 1950s Cold War design and with the exception of the F-100 and the F-105, were entirely unsuited for the war in Vietnam. The F-105 in its three separate variants was to become the workhorse of Rolling Thunder for the U.S. Air Force. It paid for that honor, as nearly 400 of this type were to be lost in the war, 88 of them lost over the North in 1967 alone. This firmly established its dubious honor of having the highest loss rate of any U.S. aircraft over the North.¹¹⁹

The F-4C model of the Phantom II was also operated by the U.S. Air Force, but again, it lacked a gun. The F-4D model, hastily rushed to theater in the spring of 1967 would offer an M61 Vulcan 20 millimeter cannon packaged in the SUU-16 gun pod. This would be a case of one step forward and two steps back though, as carriage of a SUU-16 on the centerline station of the F-4D required the removal of the large centerline drop

¹¹⁸Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses: August 1964-November 1966*, 4.

¹¹⁹Author’s calculation.

tank, significantly reducing the aircraft's range. Additionally, the F-4D was packaged with the ill-fated AIM-4 Falcon short-range infrared guided air-to-air missile. Inferior in every respect to the AIM-9 Sidewinder used with the F-4C, the Falcon was a product of fierce service rivalry, the Sidewinder having been developed by the Navy. The F-4E, built for the Air Force, and with the all-important internal 20 millimeter M-61 Vulcan cannon, would only begin delivery in November of 1968, too late for Rolling Thunder. The reconnaissance version, the RF-4C replaced the RF-101 in 1967 as the Air Force's tactical reconnaissance aircraft. Even still, nearly three times as many were lost in 1967 when compared to the RF-101.¹²⁰

Strategic bombers were not used by the Air Force over the North in great numbers. B-57B Canberra bombers were used as pathfinder aircraft in an attempt to overcome the U.S. Air Force's fundamental flaw of not having a true all weather day or night tactical attack aircraft. Two were lost in 1967 doing exactly this, demonstrating the vulnerability of large, slow aircraft flying predictable flight paths in a SA-2 missile engagement zone. An EB-66 Destroyer was also destroyed in this fashion while performing standoff jamming.

The U.S. Navy found itself at the start of Rolling Thunder to be far better suited for this type of operation. With airwings composed almost entirely of tactical aircraft, the Navy was used to working as a composite unit from the beginning. All of the aircraft onboard U.S. Navy aircraft carriers had been designed in the 1950's. F-4B Phantom II and F-8 Crusader aircraft provided fighter cover while the A-1 Skyraider, A-4 Skyhawk, and A-6 Intruder handled attack duties. The RA-5C Vigilante had originally been

¹²⁰ Author's calculation.

designed as a carrier based heavy bomber, but it's high speed made it idea for reconnaissance duties. The A-3 Skywarrior in its various variants provided refueling capability and electronic countermeasures support.

While the aircraft might have been different, the munitions between the services were widely the same. Dumb bombs ranged in size from 500 pounds to the heavy weight 3,000-pound class that was only in service with U.S. Air Force F-105s. The Snakeye delivery system for these conventional bombs was a retardation device that sprang open from the tail section of the bomb as it was released, thus retarding its fall and allowing the attacking aircraft to fly beyond the minimum safe blast radius before the bomb detonated. This allowed for low-level ingress and delivery to thwart the SA-2, though it placed the aircraft firmly in the AAA envelope. The Mk 36 Destructor was a kit that allowed dumb bombs to be sown as mines, both on land and in the water. Introduced in 1967 and used widely to impede repair of roadways and ferry crossings via time delay fuses, the Mk 36 was an important interdiction weapon.¹²¹ The CBU-24 cluster munition was the preferred weapon for suppression and destruction of air defenses. It was filled with 665 tennis ball sized bomblets that dispensed over a wide area, useful for destruction of scattered air defense sites. Furthermore, the delivery profile was easily flown and did not require a low-level release. Ironhand pilots could easily drop the munition while reacting to enemy fire as they pressed their attacks on air defenses.¹²²

¹²¹Headquarters, Pacific Air Force, *Project CHECO Report: The War in Vietnam: January-June 1967*, 105.

¹²²Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses December 1966-1 November 1968*, 40.

The Vietnam War was to see the introduction of smart weapons by the United States. The first of which was the AGM-12 Bullpup. Plagued by a short range and small warhead, the Bullpup had limited utility against hardened targets in North Vietnam.

In 1967, the Bullpup was augmented by the AGM-62 Walleye. A glide bomb, it used a television camera in the nose to lock on to targets of high contrast, and once released, flew to the point of impact without further instruction from the pilot. The U.S. Navy was the first to use them operationally on March 11, 1967 against the Than Hoa Bridge, a resolute symbol of North Vietnamese endurance. All three weapons hit the bridge, but since it was only a 1,000-pound class weapon that only contained 450 pounds of explosives, it simply lacked the firepower to bring down the spans. They were later used in 1967 with great success against targets sensitive to collateral damage, such as the MiG bases at Phuc Yen and other pinpoint targets in the Hanoi and Haiphong areas including the Paul Doumer Bridge. The Paveway guidance package that would play a huge role in the Linebacker campaign of 1972 was introduced in May of 1968, after the bombing halt in March of that year, too late to play a part in Rolling Thunder.¹²³

First launched on April 18, 1966, the AGM-45 Shrike missile was the first anti-radiation homing missile in the U.S. inventory.¹²⁴ Designed to guide itself to the offending radar via homing in on its emissions, it became a widely used weapon in the Ironhand campaign against North Vietnamese SAMs. The North Vietnamese soon learned to respect the missile and would cease emissions after a Shrike launch in order to

¹²³Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses December 1966-1 November 1968*, 42.

¹²⁴Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses August 1966-November 1966*, 32.

prevent the missile from guiding to them. This also meant that they were unable to shoot at U.S. aircraft, and any SA-2 missiles airborne would lose guidance information.

Upgrades to the missile in the spring of 1967 allowed it continue to home in enemy radars after they had shut down in self-defense. The main complaint with the Shrike was its small 150-pound fragmentation warhead, designed to perforate radar antennae. This made visual bomb damage assessment difficult, if not impossible. In response, the AGM-78 Standard Anti-Radiation Missile was developed in 1968. Like the Paveway, it was also too late for wide use in Rolling Thunder. It promised to combine the destructive potential of the CBU-24 cluster munition with the radar homing capability of the Shrike.¹²⁵

American pilots of the time were relatively well trained when compared to their North Vietnamese adversaries. Many Navy pilots in particular had seen combat in Korea.¹²⁶ Two major issues confronted the force: restrictive targeting procedures and policies that caused morale to drop, and lucrative airline pilot employment that waited for them back at home. These led to a shortage of pilots by 1966.¹²⁷ Furthermore, the services handled the tour of duty in SEA in completely different ways. The Air Force required the flying of one hundred missions over North Vietnam before rotation home. A pilot was not required to return to SEA until every other pilot in the Air Force had flown a tour of 100 missions. This policy led to a fairly high turnover rate of pilots, and more

¹²⁵*Project CHECO Report: Air Tactics Against NVN Air Ground Defenses December 1966-1 November 1968*, 32.

¹²⁶John B. Nichols, *On Yankee Station* (Annapolis, MD: United States Naval Institute, 1987), 4.

¹²⁷Smith, *Rolling Thunder*, 91.

problematically, the cross platform transfer of transport and heavy bomber pilots into tactical fighter aircraft. As the leading Air Force pilot ace of the war Steve Richie stated:

Air Force policy during the war meant that noone would be required to serve twice until everyone had been once. As a result, many who had never flown fighters or even knew the tactical mission, and many who had not flown for years, were suddenly rushed through five to six months of combat crew training and sent to South-east Asia. Quite often, on account of their rank, these men found themselves in combat leadership roles for which they were unqualified.¹²⁸

This reduced the number of senior experienced pilots in fighters in the units. The Navy on the other hand had no such hundred-mission limit. Its pilots were expected to fly missions until they were either dead or transferred to shore duty at the end of their two- to three-year tour.¹²⁹ While this allowed for concentrated experience in the squadrons, morale suffered, especially in light of the restrictive ROE imposed by the Johnson administration. Admiral Sharp commented in his book, *Strategy for Defeat*, that decisions about targets:

to be authorized, the number of sorties allowed, and in many instances even the tactics to be used by our pilots was made in a Tuesday luncheon in the White House attended by the President, the Secretary of State [Dean Rusk], the Secretary of Defense [Robert McNamara], Presidential Assistant Walter Rostow and the Presidential Press Secretary (first Bill Moyers, later George Christian). The significant point is that no professional military men, not even the chairman of the JCS, was present at these luncheons until late in 1967. The omission . . . was in my view a grave and flagrant example of his [McNamara's] persistent refusal to accept the civilian-military partnership in the conduct of our military operations.¹³⁰

¹²⁸Walter J. Boyne, *Phantom in Combat* (London: Jane's Publishing Company, 1985), 6.

¹²⁹Smith, *Rolling Thunder*, 92.

¹³⁰Levinson, 25.

Faced with the advanced IADS of North Vietnam by the end of 1965, and with the loss of the tactical initiative by the introduction of the SA-2, the Americans reacted quickly. They instituted counters to all three branches of the IADS. These included the use of powerful airborne and ship based radars to paint the MiG picture and give threat warning and vectors to MiG Combat Air Patrol fighters, the continued growth of the Ironhand mission to suppress AAA and SA-2 systems, to include the formation of Wild Weasel units to specifically hunt the SA-2, and standoff jammers to suppress the EW and GCI radars of the North.

EC-121 College Eye airborne early warning aircraft and shipboard radars known as Red Crown in the Gulf of Tonkin provided long-range radar detection and coverage of North Vietnam. These assets allowed for long-range detection of enemy MiGs, and the vectoring of fighter aircraft to intercept them. Later variants included Rivet Top, which provided a SAM locating capability and additional threat warning to strike aircraft.¹³¹

The explosive growth of the Ironhand mission, both by the Navy and the Air Force began in 1965. Initially, only the A-4E in the Navy inventory had the sensing equipment aboard it to solve the problem of locating the SAM sites and the Firecan radars directing the AAA. The Air Force soon fielded the F-100F, a two-seat version of the F-100 rigged with the same sort of locating capability. The Wild Weasel mission was born.¹³² The two services generally employed the SAM suppression forces in the same manner, using either Ironhand flights in the Navy parlance of A-4E's armed with rockets

¹³¹Headquarters Pacific Air Force, *Project CHECO Report: Tactical Electronic Warfare Operations in SEA, 1962-1968*, 43.

¹³²*Ibid.*, 29.

and AGM-45 Shrike missiles, or Wild Weasels in Air Force terms, to troll for SAMs and radar directed AAA in advance of the strike force.¹³³ The Wild Weasel was to evolve in aircraft and systems many times during Rolling Thunder. After the F-100F, the F-105F came into being, followed by the F-4C and finally the F-105G, though too late for Rolling Thunder. The toll was high though. By the fall of 1966, only four Wild Weasel aircraft were available for flights, the rest having been shot down or damaged beyond repair.¹³⁴

Standoff jamming aircraft were rushed to the theater in 1965 from Europe. Using the antiquated EB-66, which boasted 23 jammers, the U.S. Air Force provided threat warning via detection of Fansong radars and jamming of the EW/GCI radars for not only Air Force strikes, but Navy strikes as well.¹³⁵ By the beginning of 1966 however, the wide proliferation of SAMS and radars had: (1) made the survivability of these aircraft untenable, thus increasing the standoff distances required for survival and reducing jamming effectiveness drastically; and (2) created such a diverse target set that the number of required aircraft to effectively jam a target exceeded the number available. In 1967, the first reasonably effective self-protection jammer was to finally be widely available, however by the end of the year it was determined that it had not significantly reduced losses. Further refinement of the pods produced excellent results in the spring of

¹³³Headquarters Pacific Air Force, *Project CHECO Report: Tactical Electronic Warfare Operations in SEA, 1962-1968*, 42.

¹³⁴Headquarters, Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses: August 1964-November 1966*, 38.

¹³⁵Headquarters, Pacific Air Force, *Project CHECO Report: Tactical Electronic Warfare Operations in SEA, 1962-1968*, 31.

1968. However, this was to be too late to have affected the losses during Rolling Thunder's peak of 1967.¹³⁶ The Navy also provided standoff jamming from off the coast using EA-1 and later EKA-3B aircraft. By placing them overwater, they were able to maintain their standoff distances from the coastal threats, preserving their effectiveness.

Conclusion

U.S. losses during 1967 were highest of the entire Rolling Thunder campaign with 321 aircraft being downed as a direct result of operations over the North.¹³⁷ Many factors contributed to these losses: the North's advanced IADS, the MiG threat that now found itself coming of age after two years of combat, lack of effective self- protection jamming pods, failure to systematically roll back the IADS, lack of air to air training, many fighter aircraft without a gun and with unreliable missiles, and the late arrival of smart weapons and effective anti-radiation homing missiles.

The IADS could have been systematically dismantled, however by 1967, the sheer size and complexity of it made such a task prohibitive from a stand point of required sorties. Instead, suppression techniques were used. The MiG force could have been grounded by attacking and placing out of commission all of the jet capable airfields in North Vietnam. This was not accomplished until late 1967 due to political considerations from Washington. Even then, Gia Lam was considered still too politically sensitive to strike. While the craters were quickly filled in, a completion of the POL campaign of 1966 would have removed the means from which the MiGs would have

¹³⁶Headquarters Pacific Air Force, *Project CHECO Report: Tactical Electronic Warfare Operations in SEA, 1962-1968*, 41.

¹³⁷Author's calculations.

been able to fly. This would have alleviated the pressure from having fighter aircraft ill suited to fight against maneuverable MiGs. A complete disregard of electronic warfare protection for tactical aircraft in the 1950's had left the U.S. flatfooted in 1965, and placed it in a crisis requiring the development of effective jamming pods. The development timelines of smart weapons could not be hastened, nor could the lack of sufficient quantity and quality of self- protection jamming pods be remedied. What could have solved all of these problems quickly though, was a complete and total interdiction of external foreign aid to North Vietnam.

While the two rail lines from China were intermittently interdicted in 1967, the port of Haiphong remained open. Even in late 1967, an ill-conceived plan to choke the LOCs flowing from it could not be fully implemented due to seasonal weather. Had the trains from the Soviet Union and China been interdicted, and the port facilities of the North been destroyed with the waters mined, a few key things would have occurred. First, POL stocks, distributed for use in trucks to support the effort of moving material to the south, would have needed to be consolidated for MiG aircraft. This would have been especially apparent once the remaining stockpiles of POL at the airfields had been destroyed. Second, new and replacement AAA guns from Czechoslovakia and MiGs and SA-2 missiles from the Soviet Union would have never entered the country. Finally and perhaps most importantly, the flow of ammunition into the country from China would have been stopped. With no organic ammunition industry of its own, North Vietnam was heavily reliant upon ammunition imports from China to continue fighting.¹³⁸ By not allowing foreign munitions and weapons to enter the country, the North would have

¹³⁸Van Dyke, 211.

quickly exhausted its supplies. With an estimated 25,000 tons of ammunition fired monthly, this would have been especially true after 1967 when widespread introduction of self-protection jamming pods resulted in SA-2s being fired in barrages instead of singly.¹³⁹ This would have allowed U.S. air power to conduct operations at will. With no shells for the AAA, or perhaps just no replacement SA-2 missiles for their empty launchers, the North Vietnamese would have been virtually defenseless from the air, thus greatly reducing losses. From the moment the tactical initiative was lost with the introduction of the SA-2, the U.S. air forces played a game of reactive warfare instead of imposing their will upon the enemy. The costs for this gamble were nearly 1,000 aircraft and the lives of countless airmen.

¹³⁹Headquarters Pacific Air Force, *Project CHECO Report: Air Tactics Against NVN Air Ground Defenses December 1966-1 November 1968*, 3.

CHAPTER 5

LINEBACKER

The bastards have never been bombed like they're going to be bombed this time.

— President Richard Nixon, in Smith, *The Linebacker Raids*

The Prelude

In the wake of Rolling Thunder, President Lyden B. Johnson declined seeking the Democratic Party's nomination for the 1968 presidential elections. Richard Nixon was sworn in as President of the United States in January of 1969 and instituted a policy of Vietnamization of the war in SEA, which would allow a de-escalation of the war and a transition of effort from U.S. forces to the South Vietnamese leading to a withdrawal of U.S. forces from Vietnam. Accordingly, sortie rates were cut back beginning in August of 1969, beginning a trend that would continue until the spring of 1972.

Following the total bombing halt ordered by President Johnson in the fall of 1968 ending Rolling Thunder, the air war over North Vietnam entered a new, sleepier phase. General Creighton Abrams, U.S. Army, having assumed command of USMACV instituted a program of Accelerated Pacification in South Vietnam. This was to take advantage of the favorable security climate that was a result of the destruction of the Tet Offensive in the spring of 1968. As such, the force of effort of tactical air forces in Vietnam shifted to operations in South Vietnam and Laos, primarily supporting ground forces and interdicting the Ho Chi Minh Trail during Commando Hunt.¹⁴⁰

¹⁴⁰Headquarters, Pacific Air Force, *Project CHECO Report: The Air War in Vietnam 1968-1969* (Washington, DC: Government Printing Office, 1970), 3.

Additionally, flights over the North continued, but only in a limited manner for reconnaissance under the code name Blue Tree. These flights were seen as a condition of the bombing halt in 1968; being specified by the United States. However, the North Vietnamese did not share the same view and so frequently attacked the reconnaissance aircraft. These attacks led to an increase of the overall support package, to include fighter and air defense suppression aircraft to escort the single reconnaissance aircraft. After the loss of a few of these aircraft, in January of 1970 President Nixon authorized retaliatory action under the auspices of Protective Reaction, i.e. only attacking the offending North Vietnamese defenses after they had fired upon the reconnaissance aircraft. One of these strikes resulted in the shoot down of the first MiG since Rolling Thunder on March 28, 1970. Once again, an escalation had occurred over the North, though on a much smaller scale.¹⁴¹

The year 1971 remained relatively quiet over the North until late in the year when reconnaissance flights revealed a heavy concentration of NVA troops and supplies near the DMZ in Route Package I. In response to this clear danger to South Vietnam, a series of strikes was flown in December of 1971 named Proud Deep Alpha. Over a five-day period 1,025 sorties were flown below the 20th parallel by the Navy and Air Force to disrupt and destroy this burgeoning threat. While this danger was allayed for the moment, this concentration of NVA forces on the DMZ did not go unnoticed. Accordingly, in early 1972, plans were drawn up to counter future aggressions of this type.¹⁴²

¹⁴¹Smith, *The Linebacker Raids*, 34.

¹⁴²*Ibid.*, 49.

As early as January of 1972, COMUSMACV had predicted the invasion of the South:

The enemy will use MiGs, SAMs, AAA to complicate our operations. We expect his recently intensified MiG activity to continue and to be directed against our air operations. He is expected to position SAMs and AAA just north of the DMZ, and has already moved these weapons into the Laotian panhandle to count our operations in these areas. These measures will accompany intensive armor and artillery-supported ground operations against which we must be able to concentrate U.S. and VNAF [Vietnamese Air Force] air power regardless of the hostile air environment.¹⁴³

Speculation continued in February as the Tet New Year approached, with an accompanying increase in tension as memories of 1968 replayed in the minds of senior commanders. The holiday came and went though, and additional estimates stated that the NVA would not be ready to attack until the end of March.¹⁴⁴ These predictions were to become eerily accurate. On the night of March 29, 1972, the NVA unleashed an artillery barrage across the DMZ unlike anything seen as of yet in the Vietnam War. The invasion of South Vietnam by regular NVA forces had begun in the form of eight divisions and 80,000 men.¹⁴⁵

Faced with this blatant attack, President Nixon ordered an increase of aircraft into the SEA theater of operations. The policy of drawdown had left only a fraction of the force that had been in theater during Rolling Thunder. Through farsighted actuation of

¹⁴³Headquarters Pacific Air Force. *Project CHECO Report: LINEBACKER: Overview of the First 120 Days* (Washington, DC: Government Printing Office, 1973), 12.

¹⁴⁴Headquarters Pacific Air Force. *Project CHECO Report: The USAF Response to the Spring 1972 NVN Offensive: Situation and Redeployment* (Washington, DC: Government Printing Office, 1972), 12.

¹⁴⁵HQ USMACV, *Official MACV Command History, 1972* (Washington, DC: Government Printing Office, 1973), B-5.

operations Commando Flash, and Commando Fly prior to the invasion, and finally Constant Guard, the U.S. Air Force redeployed the largest number of tactical aircraft in history over a period of months. The U.S. Navy responded by simply sending more aircraft carriers, responding in a matter of days with the USS *Constellation* and *Kitty Hawk* joining the *Hancock* and *Coral Sea*, already on station. This brought more than 300 tactical naval aircraft into position by May 8th.¹⁴⁶

By April 6th, enough forces were on hand to initiate Operation Freedom Train, which initially targeted North Vietnam forces from the DMZ to the 20th parallel, with some key authorizations granted for special targets north of that line. One of these, code named Freedom Porch Bravo, was a very large strike consisting of B-52s, and a large number of Navy and Air Force tactical aircraft, along with the requisite support aircraft required for B-52 operations in the threat environment of North Vietnam. It struck Hanoi and Haiphong, as well as the Cat Bi and Kien An airfields. This initial strike destroyed half of the POL storage in the Hanoi and Haiphong areas and was in sharp contrast to the limited strikes of Rolling Thunder, immediately attacking vital areas to the North. President Nixon had no intention of a “slowly graduated escalation.”¹⁴⁷

Finally, there was alignment in national policy ends, ways and means. President Nixon, the National Security Council, and the JCS were all in violent agreement that a maximum effort was appropriate in order to blunt the invasion and set conditions for negotiations. As such, in early April, a flurry of communication ensued to ascertain the

¹⁴⁶Smith, *The Linebacker Raids*, 56.

¹⁴⁷Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER: Overview of the First 120 Days*, 14.

best path forward. CINCPAC fused the ideas and presented them to the JCS. Of note, specific actions were recommended that had been previously recommended in Rolling Thunder, such as the mining of harbors, and aggressive action against the air threat, both in the air and on the ground. Most importantly though was the authorization for decentralized command. This operation was to be planned and executed by the military professionals in theater, not bureaucrats in Washington, DC devoid of any military background.¹⁴⁸

In a television speech delivered on May 8th, President Nixon transmitted the intentions of the United States to defeat the invasion of the South via a new campaign of strategic bombing in the North. The aims were very much in alignment with those of Rolling Thunder: to reduce the amount of external aid into North Vietnam, to destroy in depth the existing supplies and war material currently existing in the North, and eliminate enemy command and control functions.¹⁴⁹ As he delivered the address, U.S. Navy A-6 and A-7 aircraft were sowing the harbor in Haiphong with mines, correcting one of the key errors of Rolling Thunder. The mines were set with a 72-hour delay, allowing foreign shipping a grace period to leave the port. In a textbook example of anti-access warfare, operation Pocket Money instantly removed an estimated nearly two-thirds of foreign aid to the North.¹⁵⁰

¹⁴⁸Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER: Overview of the First 120 Days*, 15.

¹⁴⁹HQ USMACV, *Official MACV Command History, 1972*, B-8.

¹⁵⁰Smith, *The Linebacker Raids*, 60.

The next day, May 10th was to mark the heaviest day of air battle in the entire Vietnam War as the combined air forces of the U.S. Navy and Air Force squared off against an increasingly professional air force of North Vietnam. In order to achieve the goals for Linebacker, President Nixon had relaxed the ROE. Notably were the shrinking of the restricted zones around Hanoi and Haiphong, and the abolition of prohibited zones around those cities. While the Chinese buffer zone remained in place to nurture the thawing of Sino-American relations, the restricted zones around Hanoi and Haiphong shrank to just 10 nautical miles each. Furthermore, the only targets in Linebacker that required JCS approval were those inside either the restricted or buffer zones. This greatly relaxed ROE demonstrated the decentralized nature of command and control used during Linebacker—a Vietnam version of what is today called mission command.¹⁵¹

The route package system used during Rolling Thunder was resurrected, providing deconfliction between efforts for the U.S. Air Force and Navy, with the areas assigned as before. However, it still did not provide a unity of command at the operational level, with Navy targeting being done aboard the carriers on Yankee Station and Air Force targeting being done at 7th Air Force headquarters. There was some coordination between the two, mostly for weather contingencies, but the efficacy of having a single commander still to elude the effort.

The first task was further isolating the North from foreign assistance. In addition to the mining of every other port and the coast waterways of North Vietnam, the two main railways from China would be cut. From the 10th through the 13th, a multitude of

¹⁵¹Headquarters Pacific Air Force. *Project CHECO Report: Rules of Engagement November 1969-September 1972* (Washington, DC: Government Printing Office, 1973), 53.

major bridges in the Hanoi and Haiphong areas were dropped, including the Paul Doumer bridge in Hanoi that had been rebuilt since its destruction in 1967 and the infamous Than Hoa bridge, which had been bombed several times since 1965 with no negative effect. Additionally, bridges on the northeast and northwest rail lines were also struck. The reason for this rapid and surgical cutting of vital LOCs was the use of guided weapons, specifically the Paveway I and II guided bomb. Having only been fielded in the fall of 1968, the Paveways were proving their extreme usefulness.¹⁵²

The campaign against bridges and transportation infrastructure continued throughout May, with the occasional targeting of POL stocks and the first strikes against electrical power generation coming on the 20th. By month's end, the North Vietnamese would count 68 critical road and rail bridges destroyed. While U.S. Air Force efforts were being curtailed by poor weather, demands for air support in the South, and overall coordination problems in massing the 80-some odd aircraft required for an Air Force strike, the Navy demonstrated its flexibility. Continually striking port facilities, bridges and other transportation infrastructure, their smaller package sizes and multiple waves per day allowed them to strike multiple targets a day, sometimes up to 30, while the Air Force remained grounded for weather or concentrated on a single target. This was to be a constant theme during Linebacker, with the Navy providing the lion share of the sorties.¹⁵³ In May alone, the Navy provided twice the sorties of the Air Force.¹⁵⁴

¹⁵²Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER: Overview of the First 120 Days*, 22.

¹⁵³Steven Randolph, *Powerful and Brutal Weapons* (London: Harvard University Press, 2007), 282.

With the main arteries for supply cut, attention was turned to secondary means of transport, specifically truck traffic from China and the use of small lighters to offload ships in coastal waters. Drawing on their past frustrations with armed reconnaissance in both Rolling Thunder and Commando Hunt, vehicle marshalling areas and maintenance facilities were targeted instead of attempting to pick them off along the roads. Again, the precision weapons allowed these sensitive targets in metropolitan areas to be struck without fear of collateral damage. Additionally, B-52 strikes in Route Packages I and II near the DMZ targeted transportation assets in a narrow area.

In June, a shift in targeting was proposed by the Chairman of the Joint Chiefs of Staff Admiral Thomas Moorer. His proposal was to now strike at the heart of the North. With the main arteries supplying the lifeblood to the effort in the South destroyed, the nervous system was now targeted with electrical power generation, command and control facilities and warehousing being specified for destruction, as well as the limited industrial base of the North, primarily concrete and steel works.¹⁵⁵

While the efforts against internal supplies had begun on the first day of Linebacker, June saw an increase of effort against them as well. The first two weeks of the month saw the destruction of the Bac Giang thermal power plant outside Hanoi, as well as the Lang Chi hydroelectric plant, which provided an estimated 75 percent of the industrial electricity to the entire country. Lang Chi had not been targeted during Rolling Thunder due to its proximity to a dam, which breached, would have caused widespread

¹⁵⁴Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER Operations September-December 1972*, 93.

¹⁵⁵Randolph, 295.

flooding. Now, with the use of precision weapons, Lang Chi was also reduced to rubble.¹⁵⁶

The effects of these attacks throughout June had a dramatic effect on the North Vietnamese. The destruction of electrical power generation placed an additional burden on the ever-dwindling supply of POL as diesel generators were used throughout the country to provide electricity. Transportation and consolidation of the dispersed POL stocks was difficult. Furthermore, the overall bombing effort was having an effect in the South, with captured NVA reporting a scarcity of food, weapons, and ammunition, as well as POL.¹⁵⁷

Operations in July and August continued along the same lines, with U.S. air forces running roughshod over the North Vietnamese countryside. The sortie counts continued to mount, with the Navy still providing the majority of the monthly totals. The efforts peaked in August with over 18,000 attack sorties flown in Linebacker. The seasonal weather moved in during September, restricting operations. This had limited effect though considering that by October 1st virtually every target allowed in the North had been struck. Nevertheless, pressure was maintained as a majority of the MiG bases were struck again on the 1st. On October 17th, President Nixon instituted a reduction of sorties to just 150 per day, and on the 23rd, as a sign of goodwill to the Paris peace negotiations that were ongoing, he halted bombing in the North. Linebacker I, as it became known, came to an end.

¹⁵⁶Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER: Overview of the First 120 Days*, 37.

¹⁵⁷*Ibid.*, 42.

The North's Reaction

The North Vietnamese air defense system that was in use on March 29th, 1972 was even more robust than the one fielded in 1967. With some 37 occupied SA-2 sites, and over 200 total prepared sites its SAM strength was more formidable than in 1967. Additionally, the Fansong F was now deployed, offering optical guidance of SA-2 missiles. This additional capability allowed emissions control acquisition and tracking of targets; an important advancement against American self-protection jamming pods. Lieutenant Colonel William Schwertfeger, U.S. Air Force recounts the engagement with what could have been the first operational SA-2F in North Vietnam that results in his shoot down in February of 1972, six weeks prior to the North Vietnamese invasion of the South:

Prior to 16 Feb 72, I had no idea that the SA-2 F/optically guided model . . . existed. On 16 Feb 72, I was tasked by 7th AF Frag Shop, as a 8th TFW F-4D Fast Mover Forward Air Control (FAC), to seek out and destroy North Vietnamese artillery positions in Route Pack[age] I, Just north of the DMZ, that were firing at US/SVN Fire Bases just south of the DMZ. I had the first launch of the morning, to be on target just prior to sun[rise], thus giving me time to seek out the targets prior to my fellow 8th TFW/433rd TFS laser [guided] . . . bombers arriving on target just after sun[rise], In the briefing, Intel[ligence] showed pictures of the proposed targets and briefed us of 37/57mm AAA in the area. In my prep prior to the 4AM briefing, I was in the Wolf FAC Shop reviewing photos of the area and threats. I came up with pictures of 3 SA-2 missile sites just north of the Area of Operations, ranging from 5-15 miles north. When I addressed my concerns about not mentioning this threat possibility in the target area, the Intel[ligence] officers just back peddled . . .

While in the target area, working the first flight of laser [guided] bombers and destroying two NVN field artillery pieces, we came under attack from a radar directed, Firecan Radar, 85mm gun position to our north. Our Radar Homing and Warning (RHAW) gave us warning indications prior to them firing. I flew to the site, marked it with my White Phosphorous Rocket (Willy Pete WP) and briefed the Bombers about the attack plan. Wind out of the northeast at 5-10 Kts, hit the Firecan first in the middle of the gun ring to blind the guns, and then start at the south end and work northward around the ring so that the smoke, dust and debris will not affect the laser designators view of the target. Following the destruction

of the Firecan radar and 5x85mm guns and associated ammo and personal, I then direct the remaining bombers to follow me north a few kilometers to attack a command center and associated gun positions. Here, we destroyed the command center and five associated 23/37mm gun positions. At this time, I started to get SA-2 Fansong radar indications on my RHAW showing the classic Rattle Snake Audio and Running Strobe. It was coming from the area that I had photos of [from earlier in the morning] . . . As I released my bombers to Return to Base (RTB) , I briefed my fellow FAC coming on Station about the targets destroyed and the Surface to Air Missile (SAM/SA-2) activity in our Area. I still had fuel remaining . . . so I proceeded north.

As I proceeded North toward the first SA-2 site that I had pictures of, the package of aircraft were getting RHAW of Tracking and Lock-on indications from the North. The Bombers went into Defensive Evasions, while I proceed[ed to the north]. The site of the first SAM picture was empty but was of classic Soviet Star of David design. I proceeded 4 km farther north while continuing to get RHAW indications of an impending SA-2 launch with a flashing Launch light in the aircraft. As this was happening, coming from the second site that I had pictures of, 2 SA-2's were coming off their rails toward my Aircraft. With rocket boosters still on as they approached me, I knew that they were not guiding on me, since the Guidance Antenna is not exposed until the booster comes off. I set up over this SAM site, as I called for hard bombers to be launched from Da Nang to destroy this site. As I was doing this, we continued to get indications of launch without missiles being in the air. [This was] a means of forcing the bombers to the south to stay in defensive mode.

In my aircraft, along with RHAW signals of launch, we were also getting Firecan radar indications from the southwest. The site to the north, that I had pictures of, was not showing any visual indications of launching; therefore, my assumption was [that there was] only one active SAM in the area and radar [guided] guns to the Southwest. What I did not know was [that] there was the very first SA-2F, optically guided [SAM] . . . to the west of my position. The Soviets manning the site were using Firecan radar ranging to my aircraft . . . and optical tracking so as to obscure their intent of attacking my aircraft. We had onboard, in the forward missile well, a self protection . . . jamming pod, but I had my backseater turn it off because it would make us a very large target on their Scope. Hindsight tells me I should have left it on to jam the guidance signal to the missile. This [SA-2F] site to the west of me . . . had range from the Firecan and az[imuth] and el[elevation data] from the optics for tracking. The [jamming] pod gave them NO real problem. At launch, I saw nothing from the site I was over, nor the site to the North; and the one to the south was empty, thus telling me that they were trying to keep the attacking force I had called for to remain in defensive mode. While circling the middle SAM site at about 12,000 feet, my aircraft, F-4D 602, was shot down. I was able to make one mayday call before all electronics and hydraulics were gone. The SA-2 detonated and basically removed the back of

aircraft aft of the wings. We went into a . . . flat spin . . . we were captured immediately and taken to Hanoi the next day to spend 407 days in captivity.

What I found out after my release from Hanoi, was that this SA-2F SAM site was too secret for the aircrews to know about. As I understand it, our intell[igence] folks at 7th Air Force in Saigon were listening to the Russian SAM operators as they launched the 1st SA-2F and destroyed my aircraft . . . sending Ralph Galati and myself to captivity for 407 Days. In the camp, I found out that on the next day, 17 Feb 72 another F-4 and a F-105[G Wild] Weasel were also shot down by the same site. On the third day, 18 Feb 72, that site was declassified . . . struck and destroyed.¹⁵⁸

The strength and depth of the AAA threat could not be ascertained by U.S. forces due to the lack of reconnaissance and activity since the end of Rolling Thunder. Needless to say, it was still potent. Additionally, the ZSU-23-4 had been fielded, offering a rapid-fire quad barreled 23-millimeter gun system on a highly mobile tracked chassis, paired with the Gun Dish radar system for accurate and withering fire. Lieutenant Commander John Pianetta describes his introduction to the ZSU-23-4:

The ZSU23 is an incriminating story, breaking CAG policy and employing a few acts of stupidity. The sun was going down and our target was around the Mu Gia Pass area. During our ingress south of Hanoi we got some 23[mm] thrown at us. Lead got him with the HUD and I did a flyover mark. After we dropped our [MK]82s we got a hair up our ass to pay the site a visit on the way out with our shit hot system and our 20mm cannon . . . Sun was down and dusk was almost gone. We recalled the marks and set up to bomb the mark only switch to guns after target acquisition. Lead rolled in and when he pulled the trigger a dashed orange line went down to the target(stupid [of us]-we forgot we had day loads in the cannon . . . every 5th round is a tracer). I took a 15 deg[ree] angle off leads line and rolled in. I no sooner get in the dive and all hell breaks lose all around my canopy, but I didn't see any muzzle flashes around the aiming diamond. So, I figured I would maintain the dive and press through it before I fired. Still no muzzle flashes and a steady stream of orange all around the canopy that seemed to be tracking me thru the dive. I was getting very low . . . so I started a 7g pull through the tracers. I flew through leads wake turb[ulence] at the same time and thought I was hit. The tracers stopped at the same time and as I looked in the mirrors I thought I saw fuel coming from the wing, but it was dark and as I wrapped it up and looked down I saw trees. As I checked my gauge I wasn't

¹⁵⁸William Schwertfeger, e-mail to author, May 12, 2014.

losing fuel and realized the 7Gs created a vapor trail right at the fuel dump wing fold area. We went to a tac[tical] freq to discuss and check me out. Geno was the weapons officer and apologized for not remembering we had day loads. Since he was watching this he said he had never seen such a stream of 23[mm] concentration tracking me down the chute. In retrospect it reminded me of some Phalanx footage I'd seen. We both agreed that the target had moved from the original marks and was embedded in the heavy jungle . . . The mode they used the first time was not the same we saw the second. It seemed to guide the bullets to the target(me). I have no idea why I'm still alive . . . After the IOIC debrief we then concluded what we saw was a ZSU-23. I had no [RWR] warnings and we concluded the muzzle flash was masked partially because of the thick jungle canopy and also it had hidden itself well from its original position. The terrain was hilly also. There weren't a lot of ZSU- 23s but most were up north. After the debrief I had a stiff shot and only told a trusted few.¹⁵⁹

The largest increase in capability came with the growth of its air force. The DRVAF could boast 246 jet fighters, with 93 of them being the new MiG-21F, 120 MiG-17s, and 33 MiG-19s.¹⁶⁰ Furthermore, the intervening years had allowed more pilots to be trained, and for important intercept training to be accomplished in what had been a sanctuary for them since the halt of Rolling Thunder. This was now not only a well-equipped air force, but also a well-trained one. Indications of this were discovered in the intervening years as MiGs became steadily more aggressive against operations in Laos and along the DMZ.

On May 10th, as the United States launched its first massive attack over North Vietnam since 1968, a total of 41 North Vietnamese MiGs rose to the fight. Eleven of these were destroyed. In response to the equivalent of aerial set piece battle, General Vo Nguyen Giap, North Vietnam's Defense Minister praised the courage of the pilots, but to move to "secret, surprise attacks sure to achieve victory and he criticized the erroneous

¹⁵⁹John Pianetta, e-mail message to author, May 6, 2014.

¹⁶⁰HQ USMACV, *Official MACV Command History*, 1972, B-16.

concept of seeking, 'one for one exchanges'.”¹⁶¹ A return to airborne guerilla tactics soon occurred, much like after the set piece battle defeats versus the French in the Red River delta many years before.

While many of the North Vietnamese pilots were now seasoned veterans, many of the radar operators from Rolling Thunder had been promoted or reassigned. Nevertheless, a high degree of sophisticated coordination was displayed between the SAM forces and the pilots. The coordinated launch of missiles to distract U.S. pilots while MiGs returned to their high-speed slashing attacks reflected this level of sophistication. By the end of May however, the air battle was in the favor of the United States, with 11 MiGs downed for the loss of six U.S. aircraft. Furthermore, 429 SA-2s had been fired for only six shoot downs of U.S. aircraft, a ratio of 72:1.¹⁶² With the main external supply sources cut, such a ratio was not sustainable. Accordingly, the Central Military Party Committee issued a directive on the 30th of May to “quickly adjust and update our battle plans . . . quickly review and derive lessons learned from the recent wave of battles and provide timely guidance in selecting suitable fighting methods.”¹⁶³ On June 10th the Air Defense Command issued an order that all Fansong radars were to be modified with optical guidance by June 30th, and that the forces were to be redistributed so as to attack the flanks of U.S. aircraft formations where the jamming strength would be less. The advantage of optical guidance allowed the North Vietnamese to fire the missiles without

¹⁶¹Randolph, 205.

¹⁶²HQ USMACV, *Official MACV Command History, 1972*, B-9.

¹⁶³Randolph, 283.

using the radar, thus defeating the strong U.S. jamming pods. Additionally, the SA-2s were redistributed along the vital rail lines from China.

These changes in tactics worked, though they could not stop the American onslaught. During the three-month period of June through September, the North fired 1,232 missiles and shot down 22 U.S. aircraft, a ratio of 56:1. The DRVAF fared better in June and July, downing 12 U.S. aircraft at the loss of 11 MiGs, a marked increase in their performance. However, in August, the American command and control center known as Teaball came online, and the ratio not only reversed, but it turned decidedly in the favor of U.S. pilots. During August and September, 15 MiGs were lost in exchange for only one U.S. aircraft.

By the first week of October, the SA-2 stocks were largely depleted. Furthermore, dedicated attacks on occupied missile sites, combined with the U.S. tactic of using both AGM-45 Shrike and AGM-78 STARM missiles as well as following up with conventional ordnance to suppress and destroy air defenses meant that the defense system was largely defeated. Nevertheless, 211 SAMs were fired in October, shooting down only three U.S. aircraft, for a 70:1 ratio. The DRVAF, having been deprived of POL, its airfields bombed, and its tactical advantage of GCI control largely negated by Teaball, continued to take a beating. Seven MiGs were downed with only two F-4Ds shot down in return.¹⁶⁴

The rapid application of the force of U.S. airpower, to include the advent of new technologies, along with the closure of external supply caused the North Vietnamese to these changes, there were no long-term bombing halts as there were in Rolling Thunder

¹⁶⁴HQ USMACV, *Official MACV Command History*, 1972, B-12.

to allow them time to adapt, rebuild, and replenish their defenses. Furthermore, the abolition of prohibited zones and the targeting of airfields gave the components of the IADS no sanctuary from American air power.

American Advances

The U.S. air forces in the spring of 1972 had changed when compared to those in Rolling Thunder. Not only in physical appearance with the introduction of new aircraft and retirement of others, but the tactics applied to strike formations and dogfighting as well. Additionally new capabilities had been introduced in the intervening years to include more powerful jamming pods, Radar Warning Receiver gear, and improved air-to-air and air-to-ground munitions. Furthermore, the personnel make up was different, not just in a temporal sense, but also in level of experience.

The years between Rolling Thunder and Linebacker saw the retirement and introduction of many tactical aircraft type for both the Navy and the Air Force. For the Navy's attack inventory, the introduction of the A-7A Corsair II in December of 1967 marked the beginning of the retirement of the A-4 Skyhawk, though the Skyhawk continued to serve aboard smaller deck carriers and would still see action in Linebacker. However, the venerable A-1 Skyraider would be removed from U.S. Navy service and not be used in 1972 in the skies above North Vietnam. By 1972, the A-7C/E would be in service, with improved targeting avionics, a strengthened airframe, and an M61 Vulcan 20 millimeter cannon onboard. Additionally it came ready for Ironhand service, having the requisite equipment onboard for AGM-45 Shrike targeting.¹⁶⁵ Furthermore, the E

¹⁶⁵Anthony M. Thornborough and Frank B. Mormillo, *IRONHAND: Smashing the Enemy's Air Defences* (Somerset, England: Haynes Publishing, 2002), 113.

model was the first digital bombing system in the U.S. inventory, a “smart” aircraft that when paired with a “smart weapon” was a formidable attack platform.¹⁶⁶

The A-6A Intruder was still the only true precision all weather attack capability in the entire U.S. inventory until the full introduction of the F-111 in September of 1972. The addition of the A-6B variant sprinkled amongst the A-6 squadrons allowed for another Ironhand aircraft, and was the only U.S. Navy aircraft capable of carrying the monstrous AGM-78 Standard Anti-Radiation Missile. The addition of the EA-6B Prowler to the fight in 1972 gave the Navy their first purpose built Electronic Countermeasure aircraft capable of powerful standoff jamming. These supplemented the EKA-3B Skywarrior that split its duties between tanking and standoff jamming. John Pianetta describes the introduction of the EA-6B Prowler:

[The] Prowler came on the scene as a surprise. Came out of Guam, no shipboard ops, nothing known about them. Got a message one day they would be doing their thing for a couple cycles. They would not go feet dry. We thought what the hell could they do from feet wet? WOW, what they did was sell us forever on whatever they could do. Deep North mission, unbelievable, strobes on our scope shrank and torqued faster than you could blink, and stayed quiet the whole mission, I don't think our ALQ 100 even knew what was going on. We were told anything that launched would be manual and unguided. What a first impression. We told our A-3 guys to go to Cubi and buy the drinks we don't need them anymore. So after the first exposure we always requested them but we didn't always get them. But mysteriously they showed up on all the important stuff. Then they would sometimes stage out of Cubi, always double cycled. I finally got a look at them one time and saw those 4 pods with the props spinning and thought they could make day out of night . . . the Prowler was impressive and some of us didn't want to go deep north without them. They were top secret and no one said anything about them except that we always wanted them on station. I guess their stand off capability was what surprised us the most.¹⁶⁷

¹⁶⁶John Pianetta, e-mail to author, May 4, 2014.

¹⁶⁷John Pianetta, e-mail to author, May 8, 2014.

Amongst its fighter fleet, the Navy continued to operate the F-8 Crusader on small deck carriers, upgraded now to the F-8G model with structural improvements.

Additionally, while some F-4B aircraft were still in service, the F-4J was now in service, offering a more powerful radar, maneuvering improvements, and slightly more powerful engines. However, it was still tremendously handicapped by not having an internal gun as the Air Force's F-4E had.

For the U.S. Air Force, high losses of F-105D Thunderchief aircraft during Rolling Thunder had hastened its retirement, and only the F-105G Wild Weasel III variant was to see action in Linebacker. Considered the pinnacle of F-105 development, it was initially considered still superior to the F-4C Wild Weasel IV when introduced in 1968.¹⁶⁸ The F-105G was the only Air Force aircraft capable of AGM-78 STARM carriage.

The F-4 Phantom II continued in U.S. Air Force service, most notably with the introduction of the F-4E variant in late 1967. Too late for significant action in Rolling Thunder, the E model corrected the internal gun deficiency, having been fitted with an M61 20 millimeter Vulcan cannon. Additionally its upgraded engines and avionics increased its combat effectiveness; the most important of which being Combat Tree. Combat Tree allowed for interrogation of enemy IFF, therefore solving the problem of positive hostile identification at beyond visual range. Unfortunately, only a few F-4E aircraft were to have this installed. The D model also continued to soldier on in the ranks, taking the place of the F-105D in Linebacker operations.

¹⁶⁸Thornborough and Mormillo, 95.

Introduced in a trial manner in 1968 under the program Combat Lancer with less than stellar results, the General Dynamics F-111 Aardvark was finally ready for primetime in 1972. Deployed to Thailand in September of 1972, it finally provided the U.S. Air Force with true all weather, day, or night precision bombing capability to match the Navy's A-6 Intruder. The tactics involved were the same: single aircraft strikes flown at night using terrain following techniques against radar significant point targets. Sadly, four of the six F-111s deployed in September had been lost by November, echoing the performance in 1968.¹⁶⁹

The EB-66C Destroyer continued to be used by the Air Force for standoff jamming. Though war weary it continued to provide valuable support to strike aircraft, the B-52 in particular. However, the high threat environment limited its usefulness as the longer stand off distances greatly lessened the effects of its jamming system.

U.S. munition development had continued during the intervening years. The two air-to-air missiles in the U.S. inventory having been upgraded. The AIM-9 Sidewinder was upgraded in 1968 from the B to the E model, featuring improved capabilities for engaging maneuvering targets. However, this was to be too late for Rolling Thunder operations. By 1972, a follow on variant, the AIM-9J was in the final stages of testing. Arriving in theater in September of 1972, it saw limited use and generally performed poorly in published reports.¹⁷⁰ However, Colonel Charles DeBellevue, USAF, the leading U.S. ace of the war indicated otherwise, having used them with success during many of

¹⁶⁹Headquarters Pacific Air Force, *Project CHECO Report: The F-111 in SEA September 1972-January 1973* (Washington, DC: Government Printing Office, 1974), 1.

¹⁷⁰Headquarters Pacific Air Force, *Project CHECO Report: COMBAT SNAP (AIM-9J SEA Introduction)* (Washington, DC: Government Printing Office, 1974), 10.

his engagements.¹⁷¹ The medium range air-to-air missile, the AIM-7 Sparrow was updated to the E configuration in the summer of 1966. Further refinements resulted in the AIM-7E-2 or Dogfight Sparrow with improved minimum range and additional lock on modes. Introduced in August of 1968, it missed Rolling Thunder and by 1970 was the prescribed AIM-7 variant in the fleet.¹⁷²

Throughout the Vietnam War, the U.S. fighter force was to experience abysmal air-to-air missile reliability. Causes ranged from rocket motor failure, guidance failure, to fusing failures. Additionally, many times the missiles were launched out of parameters, usually due to high-G maneuvering during a dogfight. Overall in Linebacker, the kill rate per missile fired for the AIM-9J, the AIM-9E, and the AIM-7E-2 was 13, eight, and five percent, respectively.¹⁷³ The overall fighter effectiveness was further exacerbated by the lack of a gun on the majority of the fighter aircraft, even by 1972.

The evolution of air-to-ground munitions was much more favorable in the years preceding Linebacker. The AGM-62 Walleye electro-optically guided bomb was still in the inventory, and more years of experience in its use had solidified its role as the munition of choice when a standoff release was needed from a target, or when a launch and leave capability was desired. Disadvantages included the need for sharp visual contrast in the target, which usually necessitated its use at dawn or twilight, when

¹⁷¹Charles DeBellvue, interview with author, Kansas State University, Manhattan, KS, May 1, 2014.

¹⁷²Headquarters, Pacific Air Force, *Project CHECO Report: COMBAT SNAP (AIM-9J SEA Introduction)*, 7.

¹⁷³*Ibid.*, 29.

shadows would be the sharpest. Additionally, its 1,000-pound weight class precluded its use against some heavier targets.

The Paveway I guidance system came into being during the final months of Rolling Thunder in 1968. It provided laser guidance to existing Mk 82, 83, and 84 bombs in a 500-, 1,000-, and 2,000-pound weight class respectively. Additionally, it could be installed on the M-118 3,000-pound bomb for particularly large or difficult targets. The Than Hoa bridge was finally dropped on May 13, 1972 using Paveway equipped M-118s. The Paveway II/III system provided Electro-Optical capability much like the Walleye, but with a larger bomb body. Additionally, the standoff delivery altitude of 10,000 feet allowed delivery aircraft to avoid the majority of AAA being fielded by the North Vietnamese.¹⁷⁴ Capable of pinpoint accuracy, the Paveway system provided the means by which the most politically sensitive targets were prosecuted in Linebacker I.

The development of the AGM-78 Standard Anti-Radiation Missile began in 1968. An evolutionary leap over the AGM-45A Shrike Anti-Radiation Missile, the AGM-78 was a much larger weapon weighing in at nearly 1,400 pounds with a nearly 300-pound warhead. Additionally, its seeker covered a much larger range of the electromagnetic spectrum, and thus could be targeted at not only target tracking and fire control radars, but also the larger search and early warning radars, where its larger warhead could be lethal. It could also be fired off axis from the offending radar site, and included shutdown logic, so it would continue the correct flight trajectory for impact even after the radar had shut down. Later models also included a Bomb Damage Assessment device that allowed

¹⁷⁴Headquarters Pacific Air Force, *Project CHECO Report: Second Generation Weaponry in SE* (Washington, DC: Government Printing Office, 1970), 29.

crews to determine if the missile had struck the site and destroyed it. By 1971, there were 470 upgraded AGM-78s in the inventory.¹⁷⁵ Due to its sheer size, however, only the A-6 Intruder and the F-105G Thunderchief in Wild Weasel III configuration could heft it airborne.

The Rockeye II cluster bomb was also an evolutionary leap over the CBU-24/49 used in Rolling Thunder. Containing 247 bomblets, a dual fuse was now utilized to provide either an instantaneous shaped charge against hard targets such as trucks or AAA pieces, or a timed fragmentation burst targeted towards personnel. In addition, the 200-foot by 200-foot pattern offered by the weapon provided a high probability of kill.¹⁷⁶ Used in the traditional Killer role of SAM suppression, the Rockeye was the weapon of choice in Linebacker.

The two services approached the method of striking targets in North Vietnam in entirely different ways. The Navy, with its self-contained air wings on each carrier, had the ability to launch 30-40 plane Alpha strikes composed of every type of mission role required from just one flight deck. Furthermore, due to their proximity to the coast and their assigned route packages, the air wing could muster up to three Alpha strikes per day. With a peak of seven carriers on station in July of 1972, the capability existed to mount 21 Alpha strikes per day on North Vietnamese targets. The Navy valued simplicity and flight discipline. Keeping the strike package small and the tactics simple, inoculated them against the effects of the fog and friction of war. For example, the strike package

¹⁷⁵Headquarters Pacific Air Force, *Project CHECO Report: Second Generation Weaponry in SE*, 64.

¹⁷⁶*Ibid.*, 72.

launched by the Constellation on May 10th consisted of 33 aircraft: 16 total bombers, six A-6 Intruders and 10 A-7 Corsair IIs; nine F-4 Phantoms as MiG Combat Air Patrol; another four F-4s armed with bombs and Rockeye cluster bombs for flak suppression, and two more A-7s loaded with AGM-45 Shrike missiles for SAM suppression.¹⁷⁷ The target window was compressed, and the men were disciplined. Living, training, and working together paid exceptional dividends tactically. The strike package briefed together, details could easily be ironed out, and the plan was kept simple.

In contrast, the Air Force embraced a tactic of the gaggle. Over 120 aircraft would be launched from bases all over Thailand. Of these 88 would penetrate North Vietnam, with 32 aircraft actually prosecuting the attack. The Air Force relied more on the new precision weapons, but with even more countermeasures against the air defenses of North Vietnam. Bulk chaff was now used to sow a protective corridor to blind enemy radars. However, the F-4s tasked with sowing the chaff had to fly a predictable flight path and were limited in airspeed by the chaff pod, thus making them more vulnerable to enemy SAMs and MiGs. Additional F-4s were needed to protect the chaff flight, as well as the standoff jamming aircraft and the airborne early warning aircraft. As the plan grew in complexity, so did the number of required aircraft. Because no one single base could support all the various types, they were scattered all over Thailand. This meant that the mission details were delivered the morning of the mission, with no chance for study or review. Furthermore, the pilots did not brief with each other, and the now growing list of details could not be worked out prior to the mission.

¹⁷⁷Randolph, 200.

The degenerative effects of this arrangement might have been overcome by experience. However, due to the Air Force personnel policy requiring no pilot to serve a second tour in SEA until every pilot in the Air Force had served a tour, the experience base that might have been there was not. The 7th Air Force did start a policy of squadron specialization. F-4E equipped fighter squadrons became air-to-air specialists for example due to their aircraft being equipped with an internal gun. F-4D squadrons became bombing specialists. Others became specialists in night operations while others became experts at laser guided bomb delivery.¹⁷⁸ This allowed the relatively inexperienced flight crews to focus on a smaller mission set, hopefully increasing their prowess in their specialized area. Still, the Chief of Staff of the Air Force General John D. Ryan was not impressed. He commissioned a fact-finding mission in July of 1972. The finding supported what was widely suspected: a fundamental lack of tactical training for flight crews, which led to poor flight discipline, lack of aggressiveness, and a general lack of proficiency.¹⁷⁹

These shortcomings were partially overcome in August with the introduction of Teaball. The Navy had long enjoyed far superior long-range surveillance radar coverage from its cruisers the Tokin Gulf, codenamed Red Crown. The Air Force enjoyed it as well when operating over the Red river valley. Fighter aircraft of both services could expect high quality intercept instructions from the radar controllers to enemy MiGs. In fact, Navy Chief Radarman Larry B. Novell was credited with controlling 12 intercepts

¹⁷⁸William Schwertfeger, interview with author.

¹⁷⁹Randolph, 316.

that resulted in MiG shoot downs.¹⁸⁰ However, the same level of intercept control was not available to the Air Force over western North Vietnam until Teaball was introduced in August. Once online, Air Force fighter aircraft began to be clearly vectored to enemy MiGs, and more importantly, the MiGs were not only identified at range as hostile, but by using national intelligence means, the type of MiG and the relative level of MiG pilot experience could be determined and transmitted to the fighters. Almost immediately, the kill ratio reversed itself as Air Force fighters could now begin to engage enemy MiGs at the longer ranges their AIM-7 Sparrow missiles afforded them. In General John W. Vogt's words, Commander of the 7th Air Force:

The TEABALL facility came into operation in early August when we had a loss-ratio of something like 0.47-to-one—we were losing almost twice as many as the MiGs to us. Then, with the first week's operation of TEABALL, we jumped to a four-to-one ratio for the month of August, a four-to-one in September . . . This proved one thing—if you can show the American fighter pilot where [the enemy] is in sufficient time, he'll shoot him down. Overall, and especially following the commencement of TEABALL, American pilots enjoyed a definite air superiority over North Vietnam. It was necessary if Linebacker was to continue to be productive.¹⁸¹

This advancement still did not place the Air Force on par with its fighter pilot counterparts in the Navy. As part of the review of Rolling Thunder, the Navy commissioned a review, known as the Ault Report. The Air Force commissioned their own series under the moniker of the Red Baron Reports. Of the many recommendations, one common between all the reports was the need for increased training in the area of air combat maneuvering, and Dissimilar Air Combat Maneuvering (DACT). The Navy

¹⁸⁰HQ USMACV, *Official History MACV Command History*, 1972, B-12.

¹⁸¹Headquarters Pacific Air Force, *Project CHECO report: LINEBACKER: Overview of the First 120 Days*, 46.

acted, and in 1969 founded the Navy Fighter Weapons School, better known as Topgun. By Linebacker in 1972, several Topgun graduates were flying in the skies over North Vietnam, allowing for the Navy's higher kill ratio with enemy MiGs. The Air Force however, chose to ignore the findings, even at its own Fighter Weapons School at Nellis Air Force Base, which it proudly proclaimed as The Home of the Fighter Pilot. Accordingly, no DACT training was provided. Additionally, the Air Force clung to an antiquated flight formation for its fighter aircraft from Korea known as the Fluid Four. In this formation, only the lead aircraft was allowed to fire, while the remaining three members of the flight simply tried to remain in formation, not allowed to fire. The Navy conversely employed the Loose Deuce formation. In this formation, a pair of fighters is separated by nearly a mile, allowing them to be mutually supportive of each other and keeping lookout for enemy MiGs instead of concentrating on flying formation. Furthermore, the pilot who gained sight or "tally" of the MiGs first became the "engaged" fighter and was given the priority of weapons release while the wingman protected him from additional MiGs.¹⁸² Even though the Air Defense Command had instituted a change in the U.S. to reflect the greater flexibility of the two plane formation, Tactical Air Command would not institute this change until after the end of Linebacker. Faced with the lack of institutionalized training, the leaders at the tactical level in the Air Force adapted and looked elsewhere. In August of 1972, three F-8 Crusaders from VF-24 were temporarily stationed at Udorn air base in Thailand to teach Navy DACT to the Air Force crews. Charles DeBellevue recalls:

¹⁸²Steve Davies, *Red Eagles: America's Secret MiGs* (Oxford: Osprey Publishing, 2008), 23.

The F-8's came over in July or August of 1972. After flying against them for two weeks, they were still beating the AF. I was with John Madden on a RP6 mission. The plan was, if we did not get engaged by MiGs, to launch the F-8's and meet them west of Udorn. While we were still in the Hanoi area, we jettisoned our external wing tanks to be in a normal fighting configuration when we met the F-8's. We were finally able to defeat them. We were dog fighting with a full load of missiles. That proved out the 555 TFS tactics.¹⁸³

Conclusion

At the operational level, Linebacker was conducted with the full fury of U.S. air power and corrected many of the errors of Rolling Thunder. Immediately closing the ports and severing the rail arteries of supply from China had lasting impact on the campaign. Weapons, foodstuffs, and most importantly ammunition in the form of SAMs and AAA shells for the air defenses were denied to North Vietnam. By the latter stages of the operation in October, U.S. air forces faced little resistance from SAMs with the final loss to an SA-2 occurring on the 6th of that month. This was due to the shortage of missiles as supplies ran out and the North Vietnamese technique of firing up to six missiles in salvos took its toll. Already a nation that could not feed itself due to communist communal farms, the closure of external assistance forced the North Vietnamese to throw bags of rice off ships hoping they would float ashore.¹⁸⁴ Additionally, the bombing was not halted for long periods as had been done in Rolling Thunder. Peace talks did not factor in to the bombing operations; however, there were a few short pauses of a few days around Hanoi as Soviet dignitaries visited.

¹⁸³Charles DeBellevue, e-mail to author, May 5, 2014.

¹⁸⁴Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER: Overview of the First 120 Days*, 66.

The destruction in detail of all readily targeted POL, power generation, and MiG airfields put additional stress on a logistical system that now had to provide for upwards of 15 divisions of the North Vietnamese Army locked in combat in the South. The demand for POL in particular was in stark contrast to Rolling Thunder where human portaging provided for the needs of the Viet Cong in the South. As North Vietnam struck out as a modern Army, it became more vulnerable to the necessities of a mechanized force, thus the POL campaign during Linebacker proved to be more effective. As the campaign wore on, it was estimated that the NVA were receiving only 20 percent of the required tonnage to remain on the offensive.¹⁸⁵ Destruction of the domestic and industrial electrical supply also put additional demands on the POL supply as a multitude of diesel generators were used to attempt to maintain minimal electricity in North Vietnam.

Tactically, the most profound fixture of Linebacker was the widespread use of precision guided weapons. Not only did their precision allay political fears of collateral damage, thus widening the target set available to be struck, it also caused the overall threat exposure to U.S. aircraft to be less as fewer sorties were required to destroy a target. In an interview, General John W. Vogt, Commander 7th Air Force states,

We discovered, for example, that the effectiveness of the laser-guided bomb was [much greater than] that of the conventional bombs. One day, for example, we went up and knocked out five bridges on the Northwest Rail Line with a laser strike, and when PACAF ran that through the computers, they determined that where we used 24 total bombs, it would have taken 2,400 bombs to do that by the old conventional method. Therefore, there was a tremendous breakthrough in technology and tactics.¹⁸⁶

¹⁸⁵Headquarters Pacific Air Force, *Project CHECO Report: LINEBACKER: Overview of the First 120 Days*, 65.

¹⁸⁶*Ibid.*, 59.

Additionally, the standoff range provided by the precision weapons avoided the majority of the small caliber AAA that the North Vietnamese clustered around targets. While this innovation did not regain the altitude sanctuary that was removed by the introduction of the SA-2 in 1965, it did limit the exposure to one element of the North Vietnamese IADS. This being said, AAA was still responsible for 30 percent of U.S. losses as many U.S. aircraft continued to use conventional ordnance and deliver it at low altitude.¹⁸⁷

The 1973 Arab-Israeli War is generally considered the notification to the U.S. armed forces that the tactical situation on the modern battlefield had changed. However, the use of precision guided weapons in North Vietnam demonstrates that the U.S. air forces were well ahead of their land-based peers in recognizing this trend, and were in fact pioneers of it.

Improved and more powerful self -protection-jamming pods provided protection and an electronic phalanx against North Vietnamese SAMs and radars. Additionally, every U.S. aircraft operating above North Vietnam was now equipped with a radar warning receiver of some type to provide warning of an impending SAM launch. These factors further frustrated the North Vietnamese operators, who began launching SA-2s optically or even ballistically without guidance in the hopes that the missile would break the protective formation of jets, allowing them to pick off a straggler.

Improved anti-radiation missile technology coupled with new aircraft allowed for more widespread carriage and use of Anti-Radiation Missiles. The new guidance logic and larger warhead of the AGM-78 STARM widened the target set and ensured

¹⁸⁷ Author's calculation.

destruction of the radars. With no replacement equipment being imported via sea or rail, the systematic dismantling of the North Vietnamese IADS was inevitable. The U.S. air forces conducted the first modern Suppression of Enemy Air Defenses campaign in 1972, systematically striking command centers as well as AAA, SAM, and other radar sites, as well as MiG airfields. Only the sheer mass of the North Vietnamese IADS kept it functioning into the fall of 1972. Nevertheless, the SA-2 was responsible for 29 percent of U.S. losses in Linebacker.¹⁸⁸

The most improved of the North Vietnamese defenses during Linebacker was its MiG force. Having fully matured during the intervening years and now equipped with more heavily armed and state of the art aircraft it was also now stocked with experienced and well trained pilots. Additionally, their coordination with GCI control centers allowed them to tip the kill ratios in their favor by July of 1972 using guerilla style tactics. The U.S. Air Force was particularly hard hit, with 24 of 25 air losses attributed to MiGs coming from their ranks.¹⁸⁹ Only the introduction of Teaball in August of 1972 reversed this trend.

The power of experience was also evident in the air forces of the U.S. Navy. By 1972, pilots who had multiple cruises in Rolling Thunder were now squadron commanders and air wing commanders. Additionally, the mid-grade lieutenant commanders nearly all had combat experience as well. This experience base and corporate knowledge paid tremendous dividends in tactical prowess and the resulting flight discipline. While U.S. Navy pilots flew roughly two-thirds of all Linebacker

¹⁸⁸ Author's calculation.

¹⁸⁹ Author's calculation.

sorties, U.S. Navy aircraft losses only accounted for 41 percent of U.S. aircraft lost, a testament to their professionalism.¹⁹⁰

Experience counted when going to the merge with an enemy MiG as well. Beginning in 1968, the covert Have Doughnut, Have Drill and Have Ferry programs conducted exploitation of MiG-21 and MiG-17 aircraft. This intimate knowledge of flight envelopes and systems was passed on at Topgun, with the first aces of the Vietnam War Lieutenant Randall “Duke” Cunningham and Lieutenant Junior Grade William “Irish” Driscoll providing concrete proof of the effectiveness of the program. Sadly, the Air Force did not capitalize on this information until after the war.¹⁹¹

Air Force personnel policies continued to plague the service and compromise its tactical proficiency as pilots of all ranks and professional background were continually fed into SEA, thus lowering the overall experience base of the force. This was exacerbated by centralized planning at 7th Air Force Headquarters in Saigon and the geographic dispersion of its forces, causing additional complexity and friction. There was also a general lack of leadership at all levels as several inquiries were launched throughout the summer of 1972 by both Air Force Chief of Staff John Ryan and Pacific Air Forces Commander, General Lucius Clay.¹⁹²

In many ways, Operation Linebacker proved what could be done with the appropriate political will and operational planning. Through rapid and targeted application of air power the North Vietnamese IADS, which was generally recognized in

¹⁹⁰ Author’s calculation.

¹⁹¹ Davies, 33.

¹⁹² Randolph, 315-317.

the spring of 1972 as one of the finest in the world, was brought to its knees. Virtually every lesson learned from Rolling Thunder, whether strategic, operational, or tactical, was applied. Furthermore, technologies borne of Rolling Thunder had reached maturity and were utilized with great effect. The result of this was the accomplishment of strategic and operational goals in just shy of six months and at a fraction of the cost, not only in money, but in equipment and lives as well with only 95 aircraft lost.

CHAPTER 6

ANALYSIS AND CONCLUSION

Nor ought we to believe that there is much difference between man and man, but to think that the superiority lies within him who is reared in the severest school.

— Thucydides, *History of the Peloponnesian War*

When the topic of survivability is examined, two major factors affect the efficacy and lethality of the enemy defenses. The first of these is exposure to the threat. In the case of the air war over North Vietnam, this could be measured both geographically and temporally, but given the requirement to strike a fixed target, time is the most accurate measurement. Through careful examination of the air defenses and a study of the area topography, an ideal route to the target could be drawn. This route would be ideal by virtue of bypassing defenses or by seeking to mask the aircraft from enemy radar by using mountains, for example. This ideal route would minimize the amount of time that the striking aircraft would be vulnerable, or exposed to enemy air defenses.

No matter what is done to avoid the enemy, and thus reduce exposure, at some point the defenses must be faced. This brings the second major factor into play: tactical advantage. This advantage could be manifested as a technological advantage, such as a jamming pod, or an early warning system, or by a weapon, such as the AGM-45 Shrike missile. Additionally, it could be superior tactics, or superior training that would allow one force to triumph over another. It is through these two factors that the increase in U.S. aircraft survivability between Rolling Thunder and Linebacker I will be examined.

The peak year of Rolling Thunder, 1967, saw 189,736 sorties flown over North Vietnam. This total contains all flights flown over the North, or in support of operations

over the North, such as air refueling. A total of 321 U.S. aircraft were lost; 129 belonged to the Navy, 189 to the Air Force, and 12 to the U.S. Marine Corps. This resulted in an overall survivability ratio of one loss for every 591 sorties flown.

Linebacker I was flown from May to October 1972, with sorties totaling 73,899. Again, this number contains all sorties, both combat and combat support. A total of 95 aircraft were lost in that period; 31 by the Navy, 51 by the Air Force, and five by the U.S. Marine Corps. In contrast to 1967, Linebacker I showed a 31 percent increase in U.S. aircraft survivability, with one aircraft lost for every 777 sorties flown. Through the lens of threat exposure and tactical advantage, this improvement can be explained.

In the case of Rolling Thunder and Linebacker I, the level of threat exposure at the tactical level was manipulated at the strategic level. Targeting decisions made by luncheon groups in the White House in 1967, combined with service rivalry driving high sortie counts resulted in ineffective bombing results and the same targets being struck multiple times, thus needlessly increasing the exposure to the enemy's air defenses. In the worst cases, the actual tactics to be used, including ingress and egress routes were also specified. Additionally, failure to close North Vietnam's port facilities, where 67 percent of foreign aid poured in, ensured that the potency of the defenses was never reduced. The establishment and maintenance of prohibited and restricted zones around Hanoi and Haiphong ensured sanctuary for not only critical targets, but for defenses based inside these areas. With the range of the SA-2 being nearly 20 nautical miles, the level of threat was never reduced or destroyed to prevent further exposure in the future. Instead, these areas remained bastions for defenses and critical infrastructure alike.

While the strategic goals of Linebacker were by in large the same as those of Rolling Thunder, the strategy and operations were different. Not only were tactics not dictated at the strategic level, the targets were not either. Allowing the warfighters to select the targets at the operational level and select the tactics at the tactical level ensured the minimum amount of threat exposure occurred. Restricted areas around Hanoi and Haiphong remained, but the prohibited zones were a thing of the past. The sanctuaries remained no more as the full brunt of the American air war machine was brought to bear. Perhaps most importantly, the first task of Linebacker was the closure of North Vietnam to outside aid. The immediate closure of the ports within the first few days of the operation, combined with the relentless targeting of the rail lines ensured that over time, the air defenses lost their potency as the North Vietnamese depleted their ammunition stocks. As figure 3 illustrates, SA-2 launches decreased in the latter portion of the operation as supplies of Guideline missiles were exhausted. Furthermore, bombing halts, when they did occur, were only for a few days, not weeks at a time as in Rolling Thunder. The cumulative total of these differences at the strategic level meant that the overall level of threat exposure during Linebacker was less than Rolling Thunder. This is evidenced by the fact that a greater level of bombing effectiveness was achieved in less than half the overall sorties and in less than half the time.

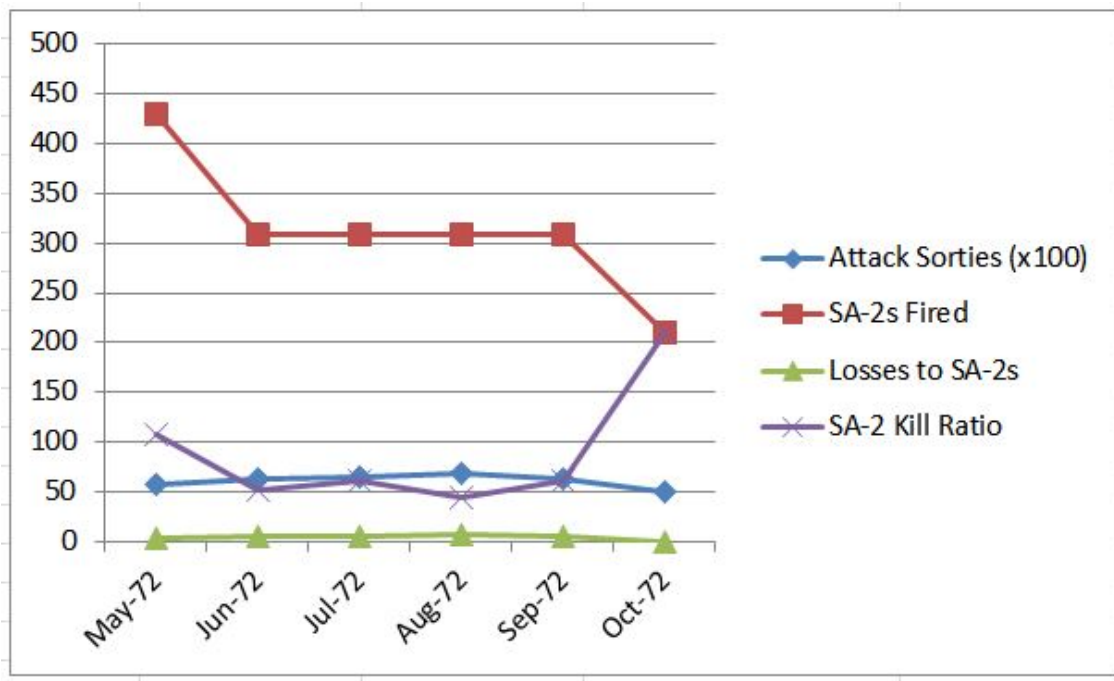


Figure 3. SA-2 Launches during Linebacker I

Source: Created by author.

Threat exposure can also be limited at the tactical level. Examination of the mode of shoot down of the two campaigns reveals shifts in the way that the aircraft were shot down. The largest shift was the reduction of the loss of aircraft by AAA and small arms, to include machine guns. As table 1 illustrates, in 1967, nearly 55 percent of losses were attributed to AAA, with another nearly nine percent to small arms. In 1972, these were reduced to 30 percent and four percent respectively. This can be attributed to the change in tactics that the introduction of guided weapons afforded.

Table 1. U.S. Fixed Wing Losses over North Vietnam

| Cause | Service | 1967 | | Linebacker | |
|--------------|---------|----------|---------------------|------------|---------------------|
| | | Subtotal | Percentage of Total | Subtotal | Percentage of Total |
| AAA | USN | 65 | 20.25% | 15 | 15.79% |
| | USAF | 101 | 31.46% | 11 | 11.58% |
| | USMC | 9 | 2.80% | 3 | 3.16% |
| CFIT | USN | 4 | 1.25% | 3 | 3.16% |
| | USAF | 4 | 1.25% | 0 | 0.00% |
| | USMC | 0 | 0.00% | 0 | 0.00% |
| Hostile Fire | USN | 1 | 0.31% | 0 | 0.00% |
| | USAF | 1 | 0.31% | 0 | 0.00% |
| | USMC | 0 | 0.00% | 0 | 0.00% |
| Malfunction | USN | 5 | 1.56% | 0 | 0.00% |
| | USAF | 2 | 0.62% | 1 | 1.05% |
| | USMC | 0 | 0.00% | 0 | 0.00% |
| Mid Air | USN | 0 | 0.00% | 0 | 0.00% |
| | USAF | 4 | 1.25% | 0 | 0.00% |
| | USMC | 0 | 0.00% | 0 | 0.00% |
| MiG | USN | 3 | 0.93% | 1 | 1.05% |
| | USAF | 21 | 6.54% | 24 | 25.26% |
| | USMC | 0 | 0.00% | 0 | 0.00% |
| Pilot Error | USN | 1 | 0.31% | 0 | 0.00% |
| | USAF | 0 | 0.00% | 0 | 0.00% |
| | USMC | 0 | 0.00% | 0 | 0.00% |
| SA-2 | USN | 34 | 10.59% | 16 | 16.84% |
| | USAF | 30 | 9.35% | 11 | 11.58% |
| | USMC | 2 | 0.62% | 1 | 1.05% |
| Small Arms | USN | 14 | 4.36% | 1 | 1.05% |
| | USAF | 13 | 4.05% | 3 | 3.16% |
| | USMC | 1 | 0.31% | 0 | 0.00% |
| Unknown | USN | 2 | 0.62% | 3 | 3.16% |
| | USAF | 4 | 1.25% | 1 | 1.05% |
| | USMC | 0 | 0.00% | 1 | 1.05% |
| Total | | 321 | 100.00 | 95 | 100.00% |

Source: Created by author.

With release altitudes of 15,000 feet or higher, the Paveway system and the AGM-62 Walleye allowed the striking aircraft to avoid the majority of the North's AAA arsenal. This is illustrated by the effective altitudes of various AAA pieces depicted in table 2. This advantage was further multiplied by the North Vietnamese shift to a preponderance of 57 millimeter and smaller AAA in 1967. This allowed for more guns that were more easily moved, but limited the effective altitude. The introduction of guided weapons created an altitude sanctuary for U.S. aircraft from the majority of North Vietnamese AAA.

Table 2. AAA Used by North Vietnamese IADS

| Weapon | Most Lethal Altitude Band |
|--------------------------|---------------------------|
| 12.7 mm on quad mounting | Ground to 1000 ft |
| 14.5 mm on twin mounting | Ground to 1300 ft |
| 37 mm | Ground to 1400 ft |
| 57 mm | 1500 to 5000 ft |
| 85 mm | 5000 to 10,000 ft |
| 100 mm | 3,000 to 30,000 ft |

Source: Alfred Price, *The History of US Electronic Warfare, Vol. III* (Arlington, VA: The Association of Old Crows, 2000), 23.

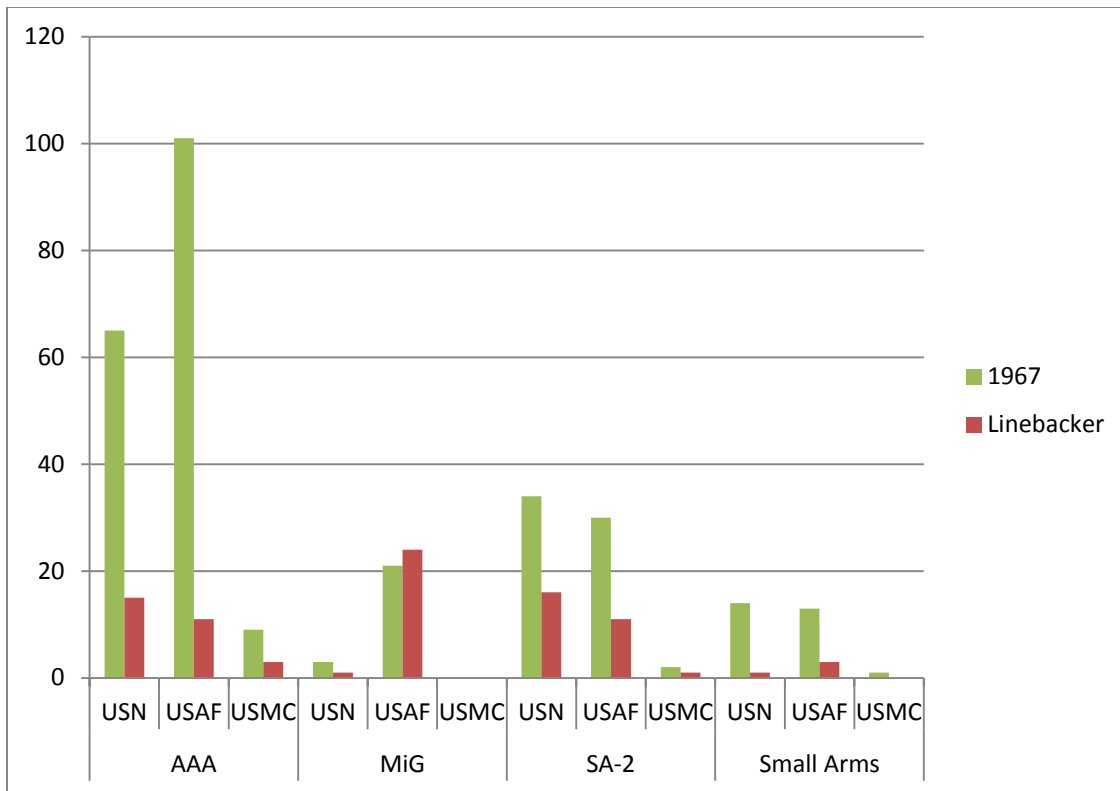


Figure 4. U.S. Fixed Wing Losses over North Vietnam by Mode of Shoot Down

Source: Created by author.

Further investigation of loss trends shows a proportional increase in losses to the SA-2 in 1972, climbing from 20 percent to 29 percent of the total losses, a nine percent increase. Similarly, losses to enemy MiGs climbed precipitously, from seven percent in 1967 to 26 percent in 1972. As strike aircraft moved to higher altitudes, they became better targets for the SA-2. Even though jamming pod technology had improved, such as the new, more powerful QRC-335, these pods required rigid adherence to flight formations to be effective. Disrupting MiG attacks scattered these formations, and the protective electronic phalanx was broken. Additionally, several aircraft were lost performing Ironhand, or suppression and destruction of the very weapons that shot them

down. The North Vietnamese Air Force had come of age during the intervening years between the two campaigns, boasting nearly double the aircraft and a huge leap in pilot tactical training and experience. Additionally, introduction of the SA-2F, with its optical tracking capability, and the retrofit of every other SA-2 with this capability in the summer of 1972 meant that the systems were virtually immune to jamming, as well as reducing the warning given to American pilots from Radar Warning Receiver sensors. The years had also allowed for important GCI training between North Vietnamese pilots and ground control stations. When combined, these advances in North Vietnamese tactics and training account for the shift in the mode of shoot down.

Other new U.S. weapons provided additional stand off from North Vietnamese air defenses, thus reducing the exposure to the threat. The AGM-78 STARM afforded a great increase in range over the AGM-45 Shrike, allowing the launch aircraft to remain outside the effective range of the SA-2 while it was being prosecuted. Furthermore, its 200-pound warhead meant that it was effective at the destruction of EW radars with larger arrays, thereby blinding the IADS, additionally reducing exposure of strike aircraft.

Tactical advantage can at times also result in a decrease in exposure. The use of precision guided weapons meant that many times the targets were effectively struck on the first mission. This meant that the number of sorties required to effectively destroy a target as compared to 1967 was greatly reduced, thus reducing the overall exposure to threat defenses. Table 3 depicts the sortie reduction gained by various precision weapons.

Table 3. Sortie Reduction Using Paveway Laser Guided Weapons

| Hitting 10' x 100' Target | | |
|--------------------------------------|--|---|
| Weapon | Sorties Required to Get 50 percent Probability of Hitting Target | Dollar Cost to get 50 percent Probability of Hitting Target |
| Mk-84 LGB | 1 | \$71,000 |
| Mk-84 Freefall Delivered in Pairs | 191 | \$3,180,000 |
| M-117 LGB | 7.5 | \$420,000 |
| M-117 Freefall | 64 | \$1,082,000 |
| AGM-62 WALLEYE | 2.5 | \$112,620 |
| AGM-12C BULLPUP | 9.5 | \$268,000 |

Source: Headquarters Pacific Air Force, *Project CHECO Report: Second Generation Weaponry in SEA* (Washington, DC: Government Printing Office, 1970), 26.

Once the exposure has been minimized, tactical advantage plays a large part in survivability. When facing an IADS, it must be systematically dismantled. The first step in this process involves blinding the defenses. With its MiGs relying on GCI control to effectively conduct their guerilla style slashing attacks, and the SA-2 batteries reliant upon the same EW radars for long-range acquisition and cueing, the North Vietnamese IADS revealed a chink in its armor. If the EW radars could be jammed or destroyed, the MiGs would be blind, and the SA-2s would be driven to optical detection and acquisition or fishing for acquisition using the Fansong radar, a near impossible task. The introduction of the EA-6B Prowler in June of 1972 with its ALQ-99 jamming pods gave

real capability against the EW radars of the North. Additionally, the AGM-78 STARM provided a destruction capability against these radars. However, the sheer number of North Vietnamese radar sites by 1972 gave them redundant systems that were resistant to these methods.

Prosecution of enemy MiGs was always frustrated by the need to visually identify and confirm their hostile status. This meant that a U.S. fighter pilot would have to close to ranges of two nautical miles or less, especially due to the small relative size of the MiGs. By doing so, he gave up employment of his long-range weapon, the AIM-7 Sparrow, which could be launched at ranges of greater than 10 nautical miles. The North Vietnamese had no such weapon, and so a huge tactical advantage was relinquished. At two nautical miles, the aircraft were now evenly matched in weaponry, the short-range AA-2 Atoll heat-seeking missile on the MiGs being the counterpart to the U.S. AIM-9 Sidewinder. In many cases, U.S. fighters were now at a disadvantage, as only the F-8G Crusader and F-4E Phantom II had internal guns by 1972 while all the various MiG types in use were equipped with them.

The solution was to reclaim the first shot opportunity. To do this, the MiGs would need to be identified as hostile at range. Enter the APX-80 Combat Tree Identification Friend or Foe interrogator. This special device would provide the only onboard ability in a U.S. fighter aircraft for hostile declaration in the entire war. Sadly, it was only installed on a handful of F-4E aircraft. The majority of Air Force MiG kills in 1972 were due to the long-range first shot opportunity provided by Combat Tree. Even with Combat Tree,

the additional capability was no panacea for positive identification.¹⁹³ Not until August of 1972 would this capability be widespread to the majority of Air Force aircraft as Teaball finally came online. This fusion center of combat information would broadcast hostile declaration of MiGs in the western route packages, complementing the same capability provided by Red Crown in the eastern packages. Once these systems were in place, the MiG kill ratio once again became favorable to the U.S.

The Navy solved the problem of hostile identification at range through use of the QRC-248 device aboard its cruisers acting in the role of Red Crown. The QRC-248 provided the same Identification Friend or Foe interrogation capability of Soviet Identification Friend or Foe as Combat Tree, and then the declaration would be transmitted by radio to the Navy fighters. The QRC-248 was also mounted in EC-121 aircraft of both the Navy and the Air Force. However, perhaps the largest advantage possessed by the Navy fighter squadrons was their training.

With the founding of Topgun in 1969, the U.S. Navy had fully embraced the need for DACT in its fighter fleet. By 1972, this training was in full effect. This is illustrated by the fact that only one Navy aircraft was shot down by a MiG in Linebacker I, while the Air Force lost 24. All aircraft lost to MiGs were F-4 Phantom IIs. Without a hostile declaration at range, the Air Force Phantoms were forced into the visual arena, where their lack of dogfighting training and Fluid Four formations put them at a disadvantage. Additionally, the Route Packages assigned to the Air Force contained primarily MiG-19s and MiG-21s, which were flown by the best pilots of the DRVAF. These route packages

¹⁹³Roger Locher, interview with author, Kansas State University, Manhattan, KS, May 1, 2014.

were veiled in poor U.S. radar coverage until the introduction of Teaball in August of 1972, moreover, when compared to the route packages assigned to the Navy, the ingress and egress routes were longer, resulting in longer exposure times to enemy defenses.¹⁹⁴ The statistics in table 1 show the result.

In 1967, the combat sortie distribution between the Air Force and the Navy was equitable at 59,000 sorties each. However, during Linebacker I, the Navy overall was to provide two-thirds of the attack sorties, yet was only responsible for 40 percent of the losses. This statistic serves to weight the overall survivability statistic of Linebacker I in the direction of the Navy. Furthermore, this level of losses mirrored the performance of the Navy in 1967 as shown in figure 5, thus displaying a steady trend of losses. With the reduction of threat exposure at the strategic and operational levels being equitable for both services during Linebacker, this would suggest that something in the Navy forces provided them with a marked advantage when compared to their Air Force counterparts. This advantage was perhaps one of the most important factors affecting the increase of survivability displayed in Linebacker I. This advantage consisted of tactics, training, and combat experience.

¹⁹⁴Roger Locher, e-mail to author, May 5, 2014; Charles DeBellevue, e-mail to author, May 5, 2014.

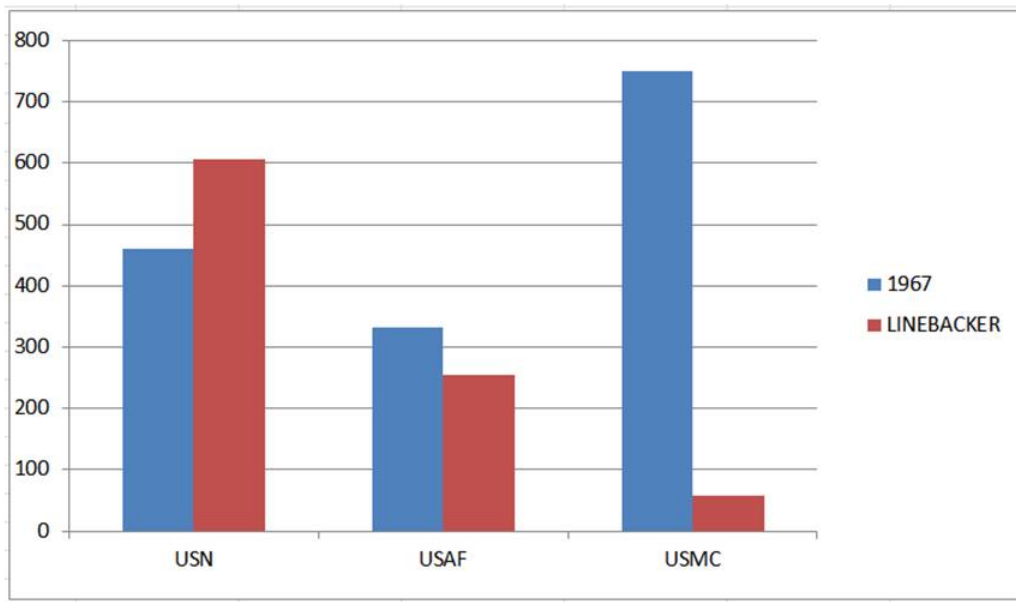


Figure 5. U.S. Fixed Wing Losses by Service, Sorties Flown per Aircraft Lost

Source: Created by author.

While the Navy had upgraded their aircraft in the intervening years, only the A-7 Corsair II was truly new. All other aircraft in the Navy fleet remained virtually the same. The A-6A Intruder was still the workhorse for U.S. all weather, day or night strike capability. Even the A-4F and the F-8J and RF-8G continued to fly off the small deck carriers brought into the fray. The F-4J enjoyed slightly more powerful engines, but it still had no internal gun. All the air-to-air missiles in U.S. service were plagued with dismal reliability and performance regardless of which service employed them. Finally, the Navy used precision weapons with much less regularity than the Air Force, preferring

to use conventional bombs. As an aside, this explains their higher losses to AAA when compared to the Air Force in 1972.

The Naval Aviators and Naval Flight Officers fielded by the Navy in 1972 enjoyed a higher standard of training than their Air Force counterparts, not only because of institutional differences, but also due to their organization. The fact that all the aircraft for a Navy alpha strike came from a single air wing aboard a single carrier wrought a multitude of advantages for the Navy. First, all the different mission roles were fulfilled by aircraft from the same air wing. Next, the pilots had been flying together for months, had completed work up training together, and were operating according to a set of air wing standard procedures. Tactical reconnaissance and intelligence was gathered by the RA-5C Vigilante aircraft assigned to the carrier. This intelligence was then used to plan the next mission. The missions were planned aboard the carrier, by the pilots that would be flying the strike. Close coordination was possible and the overall knowledge of the plan was higher due to the involvement with the planning.

Furthermore, the aviators in leadership positions were virtually all combat veterans of Rolling Thunder, and the majority had been flying the same aircraft for the majority of their careers. Red Crown aboard the cruisers in the Tonkin Gulf provided timely threat warning and GCI vectors to enemy MiGs. This all added to increased flight discipline, and simply executed plans with little external support required. Additionally, the introduction of the A-6B and the A-7 allowed for the burden of Ironhand to be distributed throughout the strike package as every A-7 was capable of carrying the AGM-45 Shrike missile.

Another major advantage of the naval flight operations was their willingness and capability to strike targets at night. Faced with an enemy air force that was not truly capable of night operations, the Navy conducted many strikes under the cover of darkness, thus removing an entire branch of the North's IADS. Furthermore, with jamming overwhelming the Fansong, flying at night defeated the optical guidance capability of the Fansong F. SA-2 launch plumes were also more easily seen at night, which allowed pilots to counter them. Flying at night meant running the risk of flying into the ground and becoming disoriented in the cockpit more easily. However, the high level of training, experience, and proficiency allowed Naval pilots to operate under these demanding conditions.

In contrast, the Air Force had retired the workhorse of Rolling Thunder, the F-105D. The F-4E boasted more powerful engines and an internal gun. They fully embraced the use of precision weapons, especially the Paveway system. Yet for all these advantages in technology, the Air Force suffered 53 percent of the air losses in Linebacker, yet only provided a third of the attack sorties. In 1967, the Air Force had provided half the sorties, while suffering 56 percent of the losses while flying over the same route packages. This trend illustrates that while the Air Force had fielded new weaponry and aircraft, the root cause of their losses lay elsewhere. The Achilles heel of the Air Force consisted of three parts: an increased MiG threat when compared to 1967, aviator personnel policy, and institutional failing in leadership and training.

Two factors ensured a higher MiG threat in the route packages assigned to the Air Force in 1972. The introduction of the MiG-19 and improved variants of the MiG-21,

coupled with the increase in experience in the DRVAF pilots assigned to fly them.¹⁹⁵

While the 100-mission policy had been repealed in late 1968, and the reversal no doubt paid dividends in 1972, it was still Air Force policy to transfer pilots from slower and less maneuverable bombers and transport aircraft into high performance jet aircraft. While their total flight experience might have been high, tactically these transferred pilots by in large were no better prepared than a brand new first lieutenant fresh out of training since they possessed the same level of tactical knowledge. This meant that there was less knowledge and experience base among Air Force aviators when compared to those in the Navy.

The wide variety of support aircraft needed for an Air Force strike meant that the component aircraft were scattered at bases all over Thailand. Additionally, the plan for the strike was assembled at 7th Air Force headquarters in Saigon and distributed just hours before the brief, resulting in a lower level of comprehension by the participating pilots. What all this amounted to was a low level of flight discipline as aircrews struggled to work through the many facets of the plan, among many more aircraft, on a single radio frequency. The fog and friction of war ensued. Also, with more than double the number of aircraft when compared to a Navy strike, the demands for protection from enemy MiGs and air defenses grew proportionally. Though deprived of training by their institution, the aircrew had no shortage of bravery. As Colonel Roger Locher put it, “We led with our heads a lot.”¹⁹⁶ This equation of more aircraft in harm’s way, flown by

¹⁹⁵Charles DeBellevue, e-mail to author, May 5, 2014.

¹⁹⁶Roger Locher, interview with author, Kansas State University, Manhattan, KS, May 1, 2014.

aircrew that were undertrained (with respect to DACT), over longer distances equaled more losses to North Vietnamese MiGs than the Navy.

Overall the U.S. air forces improved its survivability from 1967's Rolling Thunder operations to Linebacker I in 1972. While it is not possible within the limits of this thesis to quantify the effect of each of the factors identified, there is no doubt that each played a part in the increase. Had the Navy fully embraced precision weapons and the Air Force embraced DACT and introduced Teaball earlier, no doubt the losses during Linebacker would have been even lower, and the survivability been even higher.

Over the course of researching this thesis, many areas that require additional scholarship came to light. While at least one thesis has been written on the topic of the development of the Wild Weasel, and the Air Force's response to the introduction of the SA-2 in 1965, there is no counterpart detailing the development of the Navy's system of countermeasures. A thesis researching the Navy's response to the SA-2, as well as the evolution of its Ironhand mission, platforms and weapons would fill a vacuum in this area. Further research comparing and contrasting Air Force and Navy fighter tactics and command and control would go further in explaining the loss discrepancy to North Vietnamese MiGs, not only in Linebacker I, but Rolling Thunder as well. A study of the leadership, and the level of tactical proficiency created by the Air Forces' 100 mission policy would go further in explaining what effects that policy had on service effectiveness during Rolling Thunder. Finally, a thesis detailing the effects of the introduction of precision guided weapons on the tactical, operational, and strategic levels of the Vietnam War would shed additional light on these weapon system contributions to the war effort.

Finally, this study reiterates the importance of realistic training. The most powerful weapons are useless unless the operators are trained to a high level of proficiency, as evidenced by both the success of the fighter crews trained in DACT, and the failures of those that were not in Linebacker. This important lesson should be kept in mind as training budgets are eyed for possible cuts in the current fiscally restrained environment. In addition, the need to retain technological superiority was evidenced both by the struggle to overcome the tactical implications of the SA-2, specifically the need for tactical electronic warfare, and the successes of precision guided weapons. This lesson is especially true when considering the contemporary threat environment now faced by the United States. With the long development times now common, the ability to overcome initial setbacks may prove to be out of reach in the next conflict.

APPENDIX A

U.S. FIXED WING LOSSES, 1967

| Date | A/C Type | Service | Pilot Rank | Cause | Location | Notes |
|-----------|----------|---------|------------|--------------|--------------------------|-------------------------------------|
| 4-Jan-67 | A-4C | USN | O-2 | Small Arms | Thu Diem | |
| 4-Jan-67 | F-4B | USN | O-3 | Small Arms | Thu Diem | |
| 5-Jan-67 | A-4E | USN | O-4 | Malfunction | My Trach | Ordinance-Rocket FOD |
| 6-Jan-67 | RF-4C | USAF | O-3 | AAA | Bao Ha | Transition from RF-101C |
| 6-Jan-67 | F-8E | USN | O-4 | AAA | Hoang Xa | |
| 13-Jan-67 | A-4E | USN | O-2 | AAA | Vin Loc | |
| 15-Jan-67 | A-4E | USN | O-2 | AAA | Qui Vinh | |
| 16-Jan-67 | RF-4C | USAF | O-3 | AAA | Kep | |
| 16-Jan-67 | RF-4C | USAF | O-3 | SA-2 | Viet Tri | |
| 17-Jan-67 | RF-4C | USAF | O-4 | Hostile Fire | Hanoi | |
| 19-Jan-67 | A-6A | USN | O-5 | AAA | Dong Phong Thuong Bridge | |
| 19-Jan-67 | F-4C | USAF | O-3 | SA-2 | Kep | Assume SAM due to volume in area |
| 20-Jan-67 | A-4C | USN | O-2 | CFIT | Hoang Xa | Night |
| 21-Jan-67 | F-105D | USAF | O-5 | SA-2 | Thai Nguyen | |
| 21-Jan-67 | F-4C | USAF | O-3 | AAA | Kep | 100mm |
| 21-Jan-67 | F-105D | USAF | O-3 | AAA | Kep | 100mm |
| 23-Jan-67 | F-4C | USAF | O-2 | SA-2 | Son Tay | |
| 27-Jan-67 | F-4C | USAF | O-4 | Small Arms | RP1 | |
| 29-Jan-67 | F-105F | USAF | O-4 | Malfunction | Thai Nguyen | Drop Tank Separation |
| 4-Feb-67 | EB-66C | USAF | O-3 | SA-2 | Bac Kan | |
| 4-Feb-67 | F-4B | USN | O-3 | CFIT | Long Chau | Night |
| 8-Feb-67 | RF-101C | USAF | O-3 | AAA | Dong Hoi | |
| 12-Feb-67 | RA-5C | USN | O-5 | AAA | Long Chau | |
| 18-Feb-67 | F-105F | USAF | O-3 | SA-2 | Vinh | |
| 20-Feb-67 | F-4B | USN | O-4 | AAA | Thien Lin Dong | AF Pilot on Exchange |
| 28-Feb-67 | F-105D | USAF | O-3 | Small Arms | Mu Gia Pass | |
| 3-Mar-67 | F-4C | USAF | O-4 | Small Arms | Ba Don | |
| 8-Mar-67 | A-3B | USN | O-4 | AAA | Dong Hoi | Night |
| 9-Mar-67 | RA-5C | USN | O-5 | Small Arms | Long Chau | 350ft |
| 10-Mar-67 | F-105F | USAF | O-4 | AAA | Thai Nguyen | 85mm |
| 10-Mar-67 | F-4C | USAF | O-3 | AAA | Thai Nguyen | |
| 10-Mar-67 | F-4C | USAF | O-3 | AAA | Thai Nguyen | |
| 11-Mar-67 | A-4E | USN | O-5 | SA-2 | Hai Duong | |
| 11-Mar-67 | F-105D | USAF | O-3 | AAA | Thai Nguyen | 57mm |
| 11-Mar-67 | F-105D | USAF | O-3 | SA-2 | Thai Nguyen | |
| 11-Mar-67 | F-105D | USAF | O-4 | AAA | Thai Nguyen | |
| 12-Mar-67 | RF-4C | USAF | O-3 | AAA | Van Yen | |
| 15-Mar-67 | F-105D | USAF | O-5 | Unknown | Bartholemy Pass | |

| | | | | | | |
|-----------|--------|------|-----|------------|---------------|-----------------------------------|
| 15-Mar-67 | F-8C | USN | O-2 | CFIT | Thanh Hoa | Water Impact, Target Fixation? |
| 17-Mar-67 | A-1H | USN | O-4 | Small Arms | Dong Hoi | Night |
| 17-Mar-67 | A-1H | USN | O-3 | Small Arms | Dong Hoi | Night |
| 24-Mar-67 | A-6A | USN | O-4 | AAA | Kep | Night |
| 26-Mar-67 | F-105D | USAF | O-4 | Small Arms | DMZ | Iron Hand |
| 26-Mar-67 | F-4C | USAF | O-5 | SA-2 | Son Tay | |
| 27-Mar-67 | A-4C | USN | O-3 | Unknown | Dao My | |
| 31-Mar-67 | F-105D | USAF | O-3 | Small Arms | Ban Moi | |
| 2-Apr-67 | F-105D | USAF | O-3 | AAA | Dong Hoi | |
| 7-Apr-67 | A-4C | USN | O-5 | Small Arms | Mu Ron Ma | |
| 8-Apr-67 | F-4B | USN | O-3 | AAA | Cam Pha | |
| 10-Apr-67 | F-105D | USN | O-4 | AAA | Mu Gia Pass | |
| 10-Apr-67 | A-4E | USN | O-4 | AAA | Vinh | |
| 14-Apr-67 | F-105D | USAF | O-4 | AAA | Dien Bien Phu | 37mm |
| 17-Apr-67 | A-6A | USMC | O-4 | AAA | Vinh | Night |
| 19-Apr-67 | F-105F | USAF | O-4 | MiG | Xuan Mai | MiG-17 |
| 19-Apr-67 | A-1E | USAF | O-4 | MiG | Xuan Mai | MiG-17 |
| | | | | | | Thai Nguyen |
| 23-Apr-67 | F-4C | USAF | O-3 | AAA | Yen Bai | Strike |
| 24-Apr-67 | F-4B | USN | O-4 | AAA | Kep | |
| 24-Apr-67 | A-6A | USN | O-2 | AAA | Kep | 85mm |
| 24-Apr-67 | F-8C | USN | O-4 | AAA | Hon Gay | 85mm |
| 24-Apr-67 | F-4C | USAF | O-4 | AAA | Hoa Loc | 200' AGL |
| 25-Apr-67 | F-105D | USAF | O-2 | AAA | Hanoi | 85m |
| 25-Apr-67 | A-4C | USN | O-3 | MiG | Haiphong | MiG-17 |
| 25-Apr-67 | A-4E | USN | O-4 | SA-2 | Haiphong | Iron Hand |
| 25-Apr-67 | A-4E | USN | O-2 | SA-2 | Haiphong | |
| 26-Apr-67 | A-4E | USN | O-2 | AAA | Haiphong | |
| 26-Apr-67 | A-4E | USN | O-4 | SA-2 | Haiphong | Iron Hand |
| 26-Apr-67 | F-105F | USAF | O-4 | SA-2 | Hanoi | Iron Hand |
| 26-Apr-67 | F-105D | USAF | O-3 | AAA | Gia Lam | |
| 28-Apr-67 | F-105D | USAF | O-3 | MiG | Hanoi | MiG-21 |
| 29-Apr-67 | F-4C | USAF | O-2 | AAA | Hanoi | |
| | | | | | | Night Evasive |
| 29-Apr-67 | RF-4C | USAF | O-4 | CFIT | Hanoi | Manuver |
| 30-Apr-67 | F-105F | USAF | O-4 | MiG | Hanoi | MiG-21 |
| 30-Apr-67 | F-105D | USAF | O-2 | MiG | Hanoi | MiG-21 |
| 30-Apr-67 | F-105D | USAF | O-3 | MiG | Hanoi | MiG-21 |
| 3-May-67 | F-105D | USAF | O-4 | AAA | Son La | 37mm |
| 4-May-67 | A-4C | USN | O-2 | AAA | Thanh Hoa | |
| 5-May-67 | F-105D | USAF | O-2 | AAA | Hanoi | Yen Vien |
| 5-May-67 | F-105D | USAF | O-5 | AAA | Hanoi | Ha Dong 85mm |
| 5-May-67 | F-105D | USAF | O-5 | SA-2 | Hanoi | Ha Dong |
| 6-May-67 | A-4E | USN | O-2 | AAA | Thanh Hoa | |
| 8-May-67 | F-105D | USAF | O-3 | AAA | Mu Gia Pass | |
| 10-May-67 | A-4C | USN | O-5 | SA-2 | Haiphong | Kien An Airfield |
| 10-May-67 | A-4E | USMC | O-4 | SA-2 | Dong Hoi | Night |
| 12-May-67 | F-4C | USAF | O-6 | MiG | Ha Dong | MiG-17 |
| 12-May-67 | F-105D | USAF | O-3 | AAA | Nguyen Khe | |

| | | | | | | |
|-----------|---------|------|-----|--------------|-------------|---|
| 12-May-67 | F-105F | USAF | O-3 | Unknown | Ron | |
| 14-May-67 | F-4B | USN | O-4 | Malfunction | Thanh Hoa | Rocket FOD |
| 14-May-67 | F-105D | USAF | O-4 | SA-2 | Hanoi | |
| 15-May-67 | F-105F | USAF | O-3 | AAA | Kep | Night |
| 17-May-67 | F-8E | USN | O-3 | AAA | Yen Lac | 85mm |
| 18-May-67 | A-4C | USN | O-5 | AAA | Thuong Xa | |
| 18-May-67 | A-4C | USN | O-3 | Small Arms | Dong Thuong | |
| | | | | | | 1st USN Alpha Strike Ho Chi Minh Birthday (Black Friday) |
| 19-May-67 | F-4B | USN | O-5 | SA-2 | Hanoi | Walleye |
| 19-May-67 | F-4B | USN | O-2 | SA-2 | Hanoi | Black Friday |
| 19-May-67 | A-6A | USN | O-3 | SA-2 | Hanoi | Black Friday |
| 19-May-67 | F-8E | USN | O-4 | SA-2 | Hanoi | Black Friday |
| 19-May-67 | F-8C | USN | O-2 | AAA | Hanoi | Black Friday |
| 19-May-67 | RA-5C | USN | O-4 | Hostile Fire | Hanoi | Black Friday |
| 20-May-67 | A-4E | USN | O-5 | AAA | Bac Giang | Walleye |
| 20-May-67 | F-4C | USAF | O-4 | MiG | Kep | MiG-17 |
| 20-May-67 | RF-101C | USAF | O-4 | AAA | Kep | |
| 21-May-67 | F-8E | USN | O-4 | AAA | Hanoi | |
| 21-May-67 | F-4B | USN | O-3 | Small Arms | Hanoi | |
| 22-May-67 | F-4C | USAF | O-3 | AAA | Kep | Night |
| 22-May-67 | F-4C | USAF | O-4 | AAA | Kep | |
| 24-May-67 | A-4E | USN | O-2 | AAA | Ninh Binh | |
| 25-May-67 | A-1H | USN | O-1 | AAA | Vinh | |
| 25-May-67 | F-4C | USAF | O-4 | AAA | Xuan Hoa | |
| 26-May-67 | A-4E | USN | O-2 | AAA | Kep | |
| 27-May-67 | F-105D | USAF | O-3 | SA-2 | Bac Giang | |
| 30-May-67 | A-4E | USN | O-5 | SA-2 | Do Xa | |
| 30-May-67 | F-4C | USAF | O-4 | Small Arms | Tho Ngoa | |
| 31-May-67 | A-4E | USN | O-4 | AAA | Kep | |
| 31-May-67 | A-4E | USN | O-2 | AAA | Kep | |
| 31-May-67 | F-4C | USAF | O-4 | AAA | Kep | 85mm |
| 2-Jun-67 | F-105D | USAF | O-4 | AAA | Kep | |
| 2-Jun-67 | F-4C | USAF | O-3 | AAA | Tu Loan | Night |
| 3-Jun-67 | B-57B | USAF | O-4 | Unknown | RP1 | |
| 4-Jun-67 | F-105D | USAF | O-4 | AAA | RP1 | |
| 5-Jun-67 | RF-8G | USN | O-4 | AAA | Thanh Hoa | 3500'/520KIAS |
| 6-Jun-67 | F-8E | USN | O-2 | Small Arms | Thanh Hoa | |
| 6-Jun-67 | RF-8G | USN | UNK | AAA | Vinh | 57mm/Scrapped |
| 8-Jun-67 | F-4C | USAF | O-3 | AAA | Khe Phat | Night |
| 8-Jun-67 | F-4C | USAF | O-4 | AAA | Chep Le | 37mm |
| 10-Jun-67 | A-4C | USN | O-5 | SA-2 | Hanoi | Iron Hand |
| 10-Jun-67 | F-8E | USN | O-2 | AAA | Ha Dong | Hanoi |
| 11-Jun-67 | F-8C | USN | O-2 | AAA | Uong Bi | Haiphong |
| 11-Jun-67 | A-1E | USAF | O-4 | Small Arms | RP3 | |
| 11-Jun-67 | F-4C | USAF | O-5 | Mid Air | Kep | |
| 11-Jun-67 | F-4C | USAF | O-4 | Mid Air | Kep | |
| 12-Jun-67 | F-4C | USAF | O-4 | AAA | Van Loc | |

| | | | | | | |
|-----------|---------|------|-----|-------------|----------------|--------------|
| 14-Jun-67 | F-4C | USAF | O-2 | AAA | Kep | 85mm |
| 15-Jun-67 | F-105D | USAF | O-3 | AAA | Vinh | 37mm/7000' |
| 16-Jun-67 | F-105D | USAF | O-5 | AAA | Yen Hoi | |
| 19-Jun-67 | F-4B | USN | O-4 | AAA | Hanoi | |
| 21-Jun-67 | RF-101C | USAF | O-3 | SA-2 | Yen Bai | |
| 22-Jun-67 | A-4E | USN | O-4 | AAA | Hai Duong | |
| 28-Jun-67 | F-4B | USN | O-5 | AAA | Nam Dinh | 85mm/12,000' |
| 30-Jun-67 | A-4C | USN | O-3 | AAA | Ben Thuy | Vinh |
| 30-Jun-67 | A-4C | USN | O-3 | AAA | Theiu Ang | |
| 30-Jun-67 | F-105D | USAF | O-4 | AAA | Thai Nguyen | 85mm/14,000' |
| 2-Jul-67 | A-4B | USN | O-2 | AAA | Hai Duong | |
| 2-Jul-67 | F-105D | USAF | O-4 | AAA | Mu Ron Ma | |
| 2-Jul-67 | F-105D | USAF | O-3 | AAA | Xom Hai | 57mm |
| 4-Jul-67 | A-4C | USN | O-3 | AAA | Hai Duong | |
| 5-Jul-67 | F-105D | USAF | O-4 | AAA | Kep | |
| 5-Jul-67 | F-105D | USAF | O-3 | AAA | Kep | |
| 5-Jul-67 | F-105D | USAF | O-4 | AAA | Kep | 85mm/15,000' |
| 6-Jul-67 | F-4C | USAF | O-4 | AAA | Kep | |
| 6-Jul-67 | A-4E | USMC | O-4 | SA-2 | DMZ | Iron Hand |
| 9-Jul-67 | A-4C | USN | O-3 | SA-2 | Haiphong | |
| 9-Jul-67 | A-4C | USN | O-4 | SA-2 | Haiphong | |
| 10-Jul-67 | F-105D | USAF | O-4 | Small Arms | Yen Bai | Iron Hand |
| 12-Jul-67 | A-4E | USN | O-4 | Small Arms | Hai Duong | |
| 13-Jul-67 | F-105D | USAF | O-4 | AAA | Thon Cam Son | |
| 14-Jul-67 | A-4E | USN | O-2 | AAA | Gia La | |
| 14-Jul-67 | A-4C | USN | O-3 | AAA | Van Ly | |
| 14-Jul-67 | A-4C | USN | O-5 | SA-2 | Co Trai | |
| 15-Jul-67 | A-1H | USN | O-2 | Small Arms | Thanh Hoa | |
| 16-Jul-67 | F-8E | USN | O-4 | SA-2 | Hanoi | |
| 17-Jul-67 | F-105D | USAF | O-4 | AAA | Kep | 85mm/12,000' |
| 18-Jul-67 | A-4E | USN | O-4 | AAA | Co Trai | |
| 18-Jul-67 | A-4E | USN | O-2 | AAA | Co Trai | |
| 18-Jul-67 | A-4E | USN | O-2 | AAA | Co Trai | |
| 18-Jul-67 | F-4D | USAF | O-3 | AAA | Xom Duong Quan | |
| 19-Jul-67 | F-105D | USAF | O-3 | AAA | Phu Xuyen | |
| 19-Jul-67 | F-8E | USN | O-5 | AAA | Co Trai | 57mm |
| 20-Jul-67 | A-4E | USN | O-5 | AAA | My Xa | |
| 20-Jul-67 | A-4E | USN | O-3 | AAA | My Xa | |
| 24-Jul-67 | F-4C | USAF | O-4 | CFIT | Dong Hoi | Night |
| 25-Jul-67 | A-4E | USN | O-4 | CFIT | Ha Tinh | Night |
| 26-Jul-67 | F-4C | USAF | O-3 | Malfunction | Mu Ron Ma | Ord |
| 26-Jul-67 | RF-4C | USAF | O-4 | CFIT | Dong Hoi | Night |
| 28-Jul-67 | F-105D | USAF | O-2 | AAA | Dong Hoi | |
| 29-Jul-67 | F-105D | USAF | O-2 | AAA | Haiphong | |
| 30-Jul-67 | F-4C | USAF | O-3 | CFIT | Ba Binh | Night |
| 31-Jul-67 | F-8C | USN | O-2 | SA-2 | Hanoi | Rookie Note |
| 1-Aug-67 | A-4C | USN | O-3 | AAA | Hon Gay | |
| 1-Aug-67 | RF-101C | USAF | O-3 | SA-2 | Vinh Yen | |
| 2-Aug-67 | RF-4C | USAF | O-6 | Small Arms | Vinh | |
| 3-Aug-67 | F-105D | USAF | O-3 | AAA | Kep | 85mm/11,000' |

| | | | | | | |
|-----------|---------|------|-----|-------------|------------------|---|
| 4-Aug-67 | A-4E | USN | O-2 | SA-2 | Luc Nong | |
| 6-Aug-67 | F-4C | USAF | O-3 | Small Arms | DMZ | |
| 7-Aug-67 | F-4C | USAF | O-3 | AAA | Van Xuan | |
| 9-Aug-67 | A-1E | USAF | O-3 | Small Arms | NVN | |
| 9-Aug-67 | RF-4C | USAF | O-3 | AAA | NVN | |
| 11-Aug-67 | F-4C | USAF | O-4 | AAA | Thanh Land Xa | 57mm |
| 12-Aug-67 | F-8C | USN | O-4 | AAA | Hanoi | |
| 12-Aug-67 | F-105D | USAF | O-3 | AAA | Hanoi | Paul Doumer Bridge |
| 12-Aug-67 | RF-4C | USAF | O-3 | SA-2 | Hanoi | Paul Doumer Bridge |
| 13-Aug-67 | RA-5C | USN | O-4 | AAA | Na Phuc Lang Son | |
| 17-Aug-67 | F-105D | USAF | O-4 | AAA | Ba Binh | |
| 21-Aug-67 | F-4B | USN | O-5 | AAA | Chap Khe | |
| 21-Aug-67 | F-105D | USAF | O-2 | AAA | Yen Vinh | |
| 21-Aug-67 | F-105D | USAF | O-3 | AAA | Yen Vinh | |
| | | | | | | Hanoi (2x chinese shootdown from same flight) |
| 21-Aug-67 | A-6A | USN | O-5 | SA-2 | Duc Noi | |
| 22-Aug-67 | F-4D | USAF | O-2 | AAA | Mi Le | |
| 23-Aug-67 | F-105D | USAF | O-4 | AAA | Bac Giang | |
| 23-Aug-67 | F-4B | USN | O-4 | SA-2 | Lac Dao | |
| 23-Aug-67 | F-4D | USAF | O-4 | MiG | Yen Vien | MiG-21 |
| 23-Aug-67 | F-4D | USAF | O-4 | MiG | Yen Vien | MiG-21 |
| 23-Aug-67 | F-4D | USAF | O-3 | AAA | Yen Vien | |
| 23-Aug-67 | F-4D | USAF | O-4 | AAA | Yen Vien | |
| 24-Aug-67 | F-105D | USAF | O-3 | AAA | Lang Dang | 37mm/5,500' |
| 25-Aug-67 | A-4C | USN | O-2 | AAA | Vinh | |
| 25-Aug-67 | RA-3B | USN | O-5 | Unknown | NVN | |
| 25-Aug-67 | F-4C | USAF | O-3 | AAA | Xom Quan | |
| 26-Aug-67 | A-6A | USMC | O-4 | AAA | Hon Gay | |
| 28-Aug-67 | A-4E | USMC | O-4 | AAA | DMZ | |
| | | | | | | Pilot Error (high speed stall) |
| 29-Aug-67 | A-4E | USN | O-3 | Malfunction | Vinh | |
| 30-Aug-67 | A-1H | USN | O-2 | Small Arms | Vinh | |
| 31-Aug-67 | A-4E | USN | O-4 | SA-2 | Haiphong | |
| 31-Aug-67 | A-4E | USN | O-2 | SA-2 | Haiphong | |
| 31-Aug-67 | A-4E | USN | O-4 | SA-2 | Haiphong | |
| 2-Sep-67 | F-105D | USAF | O-4 | Small Arms | Dong Hoi | |
| 3-Sep-67 | F-105D | USAF | O-3 | AAA | Dong Hoi | |
| 4-Sep-67 | F-4D | USAF | O-4 | AAA | Dong Hoi | |
| 5-Sep-67 | F-4C | USAF | O-3 | AAA | DMZ | 37mm |
| 10-Sep-67 | B-57B | USAF | O-4 | AAA | Dong Hoi | |
| 12-Sep-67 | RF-4C | USAF | O-3 | AAA | Dong Hoi | |
| 16-Sep-67 | RF-101C | USAF | O-4 | MiG | Son La | MiG-21 |
| 16-Sep-67 | RF-101C | USAF | O-3 | AAA | RP6 | |
| 16-Sep-67 | RF-4C | USAF | O-4 | AAA | DMZ | |
| 17-Sep-67 | RF-4C | USAF | O-4 | SA-2 | Hoang Lien | |
| 18-Sep-67 | A-4C | USN | O-4 | SA-2 | Haiphong | |
| 19-Sep-67 | F-4D | USAF | O-4 | SA-2 | Phuc Yen | |

| | | | | | | |
|-----------|--------|------|-----|-------------|------------|----------------|
| 21-Sep-67 | RF-8G | USN | O-4 | AAA | Haiphong | |
| 23-Sep-67 | F-105D | USAF | O-4 | AAA | Ban Katoi | Radar Directed |
| 26-Sep-67 | F-4B | USMC | O-4 | AAA | DMZ | 85mm |
| 27-Sep-67 | A-4E | USMC | O-4 | AAA | DMZ | |
| 29-Sep-67 | F-4B | USMC | O-5 | AAA | DMZ | |
| 3-Oct-67 | F-4D | USAF | O-4 | MiG | Hanoi | MiG-21 |
| 3-Oct-67 | F-105D | USAF | O-4 | SA-2 | Dau Cap | |
| 3-Oct-67 | A-4B | USN | O-2 | AAA | Haiphong | |
| 4-Oct-67 | A-4C | USN | O-4 | AAA | Haiphong | |
| 4-Oct-67 | F-105F | USAF | O-4 | AAA | Hanoi | |
| 5-Oct-67 | F-8C | USN | O-1 | AAA | Nho Quan | |
| 5-Oct-67 | F-105D | USAF | O-3 | AAA | Kep | |
| 7-Oct-67 | A-4E | USN | O-3 | SA-2 | Hanoi | Iron Hand |
| 7-Oct-67 | F-4D | USAF | O-4 | SA-2 | Hanoi | |
| 7-Oct-67 | F-105F | USAF | O-3 | MiG | Kep | MiG-21 |
| 7-Oct-67 | F-105D | USAF | O-4 | AAA | Kep | 85mm/12,000' |
| 9-Oct-67 | A-4E | USN | O-2 | AAA | Nao Quan | |
| 9-Oct-67 | F-105D | USAF | O-4 | MiG | Quang Hein | MiG-21 |
| 12-Oct-67 | F-4C | USAF | O-3 | AAA | DMZ | |
| 13-Oct-67 | F-4B | USMC | O-5 | AAA | DMZ | 37mm |
| 14-Oct-67 | RA-3B | USN | O-4 | AAA | Thanh Hoa | |
| 15-Oct-67 | F-4C | USAF | O-6 | AAA | Dong Hoi | |
| 17-Oct-67 | F-105D | USAF | O-4 | AAA | Bac Ninh | 85mm/19,000' |
| 17-Oct-67 | F-105D | USAF | O-4 | AAA | Bac Ninh | 85mm/19,000' |
| 17-Oct-67 | F-105D | USAF | O-3 | AAA | Bac Ninh | 6,000' |
| 17-Oct-67 | A-4E | USN | O-2 | Malfunction | Hon Gay | Rocket FOD |
| 18-Oct-67 | A-4E | USN | O-4 | AAA | Haiphong | Iron Hand |
| 22-Oct-67 | A-4E | USN | O-2 | Small Arms | Haiphong | |
| 24-Oct-67 | F-105D | USAF | O-3 | AAA | Kep | 85mm/13,000' |
| 24-Oct-67 | A-4E | USN | O-2 | AAA | Haiphong | 6,500' |
| 24-Oct-67 | F-4B | USN | O-5 | SA-2 | Phuc Yen | |
| 24-Oct-67 | F-4B | USN | O-2 | SA-2 | Phuc Yen | |
| 25-Oct-67 | F-105D | USAF | O-4 | AAA | Hanoi | Paul Doumer |
| 25-Oct-67 | F-105D | USAF | O-3 | AAA | Phuc Yen | Bridge |
| 25-Oct-67 | A-4E | USN | O-3 | AAA | Phuc Yen | 57mm |
| 26-Oct-67 | A-4E | USN | O-5 | SA-2 | Phuc Yen | |
| 26-Oct-67 | A-4E | USN | O-4 | SA-2 | Hanoi | John McCain |
| 26-Oct-67 | F-8E | USN | O-2 | SA-2 | Hanoi | |
| 27-Oct-67 | F-105D | USAF | O-6 | SA-2 | Hanoi | |
| 27-Oct-67 | F-4D | USAF | O-3 | AAA | Phuc Yen | |
| 27-Oct-67 | F-105D | USAF | O-4 | SA-2 | Phuc Yen | |
| 27-Oct-67 | F-105D | USAF | O-3 | AAA | Hanoi | |
| 28-Oct-67 | F-105D | USAF | O-5 | AAA | Hanoi | 37mm/6,000' |
| 29-Oct-67 | F-4B | USMC | O-4 | Small Arms | DMZ | |
| 30-Oct-67 | F-4B | USN | O-4 | Malfunction | Thanh Hoa | AIM-7 FOD |
| 30-Oct-67 | A-6A | USMC | O-3 | AAA | Hanoi | Night |
| 2-Nov-67 | A-4E | USN | O-2 | AAA | Vinh | |
| 2-Nov-67 | A-6A | USN | O-4 | AAA | Van La | Night |

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|-----------|--------|------|-----|-------------|-----------|-------------------------|
| 5-Nov-67 | F-105D | USAF | O-3 | AAA | Phuc Yen | 57mm |
| 5-Nov-67 | F-105F | USAF | O-4 | AAA | Phuc Yen | 37mm Ironhand |
| 6-Nov-67 | F-105D | USAF | O-4 | SA-2 | Gia Lam | |
| 7-Nov-67 | F-105D | USAF | O-4 | AAA | Lang Gia | |
| 7-Nov-67 | F-4C | USAF | O-3 | AAA | Tho Ngoa | 57mm |
| 8-Nov-67 | F-100C | USAF | O-3 | AAA | Dong Hoi | |
| 8-Nov-67 | F-4D | USAF | O-3 | MiG | Yen Bai | MiG-21 |
| 8-Nov-67 | F-105D | USAF | O-3 | AAA | Phuc Yen | |
| 10-Nov-67 | F-4C | USAF | O-4 | Mid Air | Dong Hoi | Mid Air questionable |
| 10-Nov-67 | F-4C | USAF | O-5 | Mid Air | Dong Hoi | Mid Air questionable |
| 16-Nov-67 | F-4B | USN | O-4 | SA-2 | Hai Duong | |
| 17-Nov-67 | F-105D | USAF | O-4 | SA-2 | Bac Mai | |
| 17-Nov-67 | A-4C | USN | O-3 | SA-2 | Hanoi | Iron Hand |
| 17-Nov-67 | F-4B | USN | O-5 | SA-2 | Hanoi | Poss GLOC |
| 17-Nov-67 | RF-4C | USAF | O-4 | SA-2 | Hanoi | |
| 18-Nov-67 | F-105F | USAF | O-4 | MiG | Phuc Yen | MiG-21/ Bad Wx |
| 18-Nov-67 | F-105D | USAF | O-5 | MiG | Phuc Yen | MiG-21 |
| 18-Nov-67 | F-105D | USAF | O-4 | SA-2 | Phuc Yen | |
| 18-Nov-67 | F-105D | USAF | O-6 | SA-2 | Phuc Yen | |
| 19-Nov-67 | F-105F | USAF | O-4 | SA-2 | Cat Ngoi | Iron Hand |
| 19-Nov-67 | F-4B | USN | O-4 | MiG | Haiphong | |
| 19-Nov-67 | F-4B | USN | O-2 | MiG | Haiphong | |
| 19-Nov-67 | RF-4C | USAF | O-5 | SA-2 | Phuc Yen | |
| 19-Nov-67 | F-105D | USAF | O-4 | SA-2 | Hanoi | |
| 19-Nov-67 | F-105D | USAF | O-3 | SA-2 | Hanoi | |
| 20-Nov-67 | RF-4C | USAF | O-5 | AAA | Hanoi | 85mm/12,000' |
| 20-Nov-67 | F-4C | USAF | O-3 | AAA | DMZ | |
| 20-Nov-67 | F-105D | USAF | O-3 | MiG | Yen Bai | MiG-21 |
| 23-Nov-67 | RF-4C | USAF | O-4 | Unknown | NVN | Pilot 48 yrs old |
| 25-Nov-67 | A-6A | USMC | O-5 | AAA | Haiphong | Night |
| 26-Nov-67 | F-4C | USAF | O-6 | AAA | Ban Karai | |
| 5-Dec-67 | F-8C | USN | O-3 | AAA | RP1A | |
| 14-Dec-67 | F-105D | USAF | O-3 | AAA | Hanoi | Paul Doumer Bridge |
| 16-Dec-67 | F-4D | USAF | O-4 | MiG | Kep | MiG-21 |
| 16-Dec-67 | F-4B | USN | O-4 | AAA | Haiphong | |
| 17-Dec-67 | F-4D | USAF | O-4 | MiG | Yen Bai | MiG-17 |
| 17-Dec-67 | F-105D | USAF | O-2 | MiG | Lang Lau | MiG-21 |
| 18-Dec-67 | F-4C | USAF | O-6 | AAA | DMZ | 57mm |
| 18-Dec-67 | F-4D | USAF | O-4 | AAA | Dong Hoi | |
| 20-Dec-67 | F-100C | USAF | O-4 | AAA | Dong Hoi | 57mm |
| 22-Dec-67 | A-4E | USN | O-4 | AAA | Vinh | Self Frag? |
| 22-Dec-67 | A-7A | USN | O-4 | SA-2 | Haiphong | Iron Hand |
| 27-Dec-67 | F-4B | USN | O-4 | Pilot Error | Vinh | Spatial D |
| 27-Dec-67 | F-4C | USAF | O-4 | Small Arms | Tho Ngoa | |
| 29-Dec-67 | F-4B | USN | O-3 | Small Arms | Cam Pha | |

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|-----------|--------|------|-----|------|----------|-----------|
| 30-Dec-67 | F-100F | USAF | O-4 | AAA | Dong Hoi | 57mm |
| 31-Dec-67 | A-6A | USN | O-4 | SA-2 | Vinh | Singleton |

Source: Chris Hobson, Vietnam Air Losses: United States Air Force, Navy and Marine Corps Fixed Wing Aircraft Losses in SEA 1961-1973 (Hinckley, England: Midland, 2001).

APPENDIX B

U.S. FIXED WING LOSSES, LINEBACKER I

| Date | A/C Type | Service | Pilot Rank | Cause | Location | Notes |
|-----------|----------|---------|------------|------------|-------------|---------------------|
| 10-May-72 | F-4D | USAF | O-4 | MiG | Hanoi | MiG-19 |
| 10-May-72 | F-4E | USAF | O-3 | MiG | Hanoi | MiG-19 |
| 10-May-72 | F-4J | USN | O-5 | AAA | Hai Duong | 85mm |
| 10-May-72 | F-4J | USN | O-3 | SA-2 | Nam Dinh | |
| 11-May-72 | F-105G | USAF | O-4 | MiG | Hanoi | MiG-21 |
| 11-May-72 | F-4D | USAF | O-5 | MiG | Thai Nguyen | MiG-21 |
| 12-May-72 | F-4E | USAF | O-3 | AAA | NVN | |
| 17-May-72 | A-7E | USN | O-5 | AAA | Dong Hoi | 37mm |
| 18-May-72 | F-4D | USAF | O-1 | MiG | Kep | MiG-19 |
| 19-May-72 | A-7B | USN | O-3 | AAA | Ha Tinh | Ironhand |
| 20-May-72 | F-4D | USAF | O-2 | MiG | Hanoi | MiG-21 |
| 23-May-72 | A-7B | USN | O-5 | SA-2 | Nam Dinh | |
| 23-May-72 | F-4D | USAF | O-3 | Small Arms | DMZ | |
| 24-May-72 | F-8J | USN | O-3 | SA-2 | NVN | |
| 24-May-72 | A-7E | USN | O-4 | SA-2 | Haiphong | Ironhand |
| 25-May-72 | A-4F | USN | O-5 | AAA | Vinh | |
| 27-May-72 | A-4F | USN | O-3 | AAA | Vinh | |
| 29-May-72 | A-6A | USMC | O-4 | AAA | Haiphong | |
| 1-Jun-72 | F-4E | USAF | O-3 | SA-2 | Yen Bai | |
| 6-Jun-72 | F-4D | USAF | O-4 | SA-2 | Yen Bai | |
| 7-Jun-72 | RA-5C | USN | O-4 | SA-2 | Haiphong | |
| 8-Jun-72 | F-4E | USAF | O-3 | Small Arms | DMZ | |
| 11-Jun-72 | A-6A | USMC | O-3 | AAA | Nam Dinh | Possible overstress |
| 13-Jun-72 | F-4E | USAF | O-2 | MiG | Yen Bai | MiG-21 |
| 13-Jun-72 | A-7A | USN | O-4 | SA-2 | Vinh | |
| 16-Jun-72 | RF-8G | USN | O-3 | AAA | Thanh Hoa | 37mm/4500'/450KIA |
| 17-Jun-72 | A-7E | USN | O-5 | SA-2 | Thanh Hoa | |
| 17-Jun-72 | A-7A | USN | O-3 | Unknown | Ha Tinh | |
| 18-Jun-72 | F-4J | USN | O-4 | AAA | Vinh | 23mm |
| 20-Jun-72 | F-8J | USN | O-5 | AAA | Mu Gia Pass | 37mm |
| 20-Jun-72 | A-1J | USAF | O-3 | AAA | Mu Gia Pass | 23mm |
| 21-Jun-72 | F-4E | USAF | O-3 | MiG | Piu Tho | MiG-21 |
| 24-Jun-72 | F-4E | USAF | O-3 | MiG | Thai Nguyen | MiG-21 |
| 24-Jun-72 | F-4D | USAF | O-3 | MiG | Thai Nguyen | MiG-21 |
| 25-Jun-72 | A-7E | USN | O-3 | CFIT | Vinh | |
| 27-Jun-72 | F-4E | USAF | O-3 | MiG | Bac Mai | MiG-21 |
| 27-Jun-72 | F-4E | USAF | O-5 | SA-2 | Bac Mai | |
| 27-Jun-72 | F-4E | USAF | O-3 | MiG | Bac Mai | MiG-21 |
| 27-Jun-72 | F-4E | USAF | O-4 | MiG | Bac Mai | MiG-21 |
| 1-Jul-72 | F-4E | USAF | O-4 | SA-2 | Kep | |
| 3-Jul-72 | F-4E | USAF | O-3 | Small Arms | Ha Tinh | |
| 5-Jul-72 | F-4E | USAF | O-4 | MiG | Kep | MiG-21 |
| 5-Jul-72 | F-4E | USAF | O-3 | MiG | Kep | MiG-21 |

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|-----------|--------|------|-----|-------------|-----------|------------------------|
| 5-Jul-72 | F-4D | USAF | O-3 | SA-2 | Kep | MiG-21 |
| 8-Jul-72 | F-4E | USAF | O-5 | MiG | Hanoi | |
| 9-Jul-72 | A-4F | USN | O-5 | CFIT | Dam Khanh | Night |
| 10-Jul-72 | F-4J | USN | O-3 | MiG | Kep | MiG-17 |
| 11-Jul-72 | A-4F | USN | O-4 | SA-2 | Hai Duong | Ironhand |
| 12-Jul-72 | F-4E | USAF | O-2 | SA-2 | Dong Hoi | |
| 17-Jul-72 | A-7B | USN | O-3 | CFIT | Hon Nieu | Night |
| 20-Jul-72 | F-4D | USAF | O-3 | AAA | Kep | 5000' |
| 22-Jul-72 | RF-8G | USN | O-4 | Small Arms | Thanh Hoa | |
| 23-Jul-72 | A-7B | USN | O-2 | AAA | Ho Doi | |
| 23-Jul-72 | A-7B | USN | O-4 | AAA | Da Thit | 3500' |
| 24-Jul-72 | F-4E | USAF | O-3 | MiG | Kep | MiG-21 |
| 29-Jul-72 | F-4E | USAF | O-3 | MiG | Kep | MiG-21 |
| 29-Jul-72 | F-105G | USAF | O-4 | Malfunction | Kep | AIM-9 Frag |
| 30-Jul-72 | F-4D | USAF | O-5 | SA-2 | Hanoi | |
| 30-Jul-72 | F-4D | USAF | O-3 | MiG | Hanoi | |
| 6-Aug-72 | A-7B | USN | O-3 | SA-2 | Loi Dong | Ironhand |
| 6-Aug-72 | A-7A | USN | O-3 | SA-2 | Vinh | Night/3500'/300KIA |
| 13-Aug-72 | RF-4C | USAF | O-3 | AAA | DMZ | 57mm |
| 16-Aug-72 | F-4J | USN | O-5 | SA-2 | Haiphong | |
| 17-Aug-72 | A-7A | USN | O-4 | SA-2 | Phu Ly | Ironhand |
| 19-Aug-72 | RF-4C | USAF | O-3 | SA-2 | Kep | |
| 19-Aug-72 | A-6A | USN | O-3 | Unknown | Cam Pha | Poor Wx/Night |
| 25-Aug-72 | F-4D | USAF | O-5 | AAA | Haiphong | 37mm |
| 25-Aug-72 | F-4B | USN | O-4 | SA-2 | Nam Dinh | |
| 27-Aug-72 | F-4B | USN | O-3 | SA-2 | Phu Ly | |
| 6-Sep-72 | A-6A | USN | O-4 | SA-2 | Kien An | |
| 6-Sep-72 | A-4F | USN | O-3 | AAA | Thanh Hoa | 23mm |
| 7-Sep-72 | A-7B | USN | O-4 | Unknown | Vinh | Lightning Strike? CFIT |
| 8-Sep-72 | F-4J | USN | O-5 | AAA | Vinh | 23mm |
| 9-Sep-72 | F-4E | USAF | O-3 | AAA | Hanoi | |
| 10-Sep-72 | A-7C | USN | O-2 | SA-2 | Hanoi | Ironhand |
| 10-Sep-72 | F-4E | USAF | UNK | AAA | Dong Hoi | 23mm |
| 11-Sep-72 | F-4E | USAF | O-3 | MiG | Kep | MiG-21 |
| 11-Sep-72 | F-4J | USMC | O-4 | SA-2 | Haiphong | |
| 11-Sep-72 | F-4J | USMC | O-3 | AAA | Haiphong | |
| 12-Sep-72 | F-4E | USAF | O-3 | MiG | La Danh | MiG-21 |
| 12-Sep-72 | A-7A | USN | O-3 | AAA | Dong Hoi | |
| 16-Sep-72 | F-4D | USAF | O-3 | AAA | Hon La | |
| 16-Sep-72 | A-6A | USN | O-5 | AAA | Haiphong | |
| 17-Sep-72 | F-105G | USAF | O-3 | SA-2 | Haiphong | |
| 19-Sep-72 | A-7E | USN | O-3 | AAA | Ninh Xa | |
| 22-Sep-72 | RF-4C | USAF | O-3 | AAA | Xuan Noa | 23mm/4500'/530KIA |
| 29-Sep-72 | F-105G | USAF | O-5 | SA-2 | Phuc Yen | Ironhand |
| 5-Oct-72 | F-4D | USAF | O-3 | MiG | Yen Bai | MiG-21 |
| 5-Oct-72 | F-4E | USAF | O-3 | AAA | Xom Quan | |
| 6-Oct-72 | F-4E | USAF | O-3 | MiG | NVN | |
| 6-Oct-72 | F-4E | USAF | O-5 | SA-2 | Son Tay | |
| 10-Oct-72 | F-4E | USAF | O-3 | Unknown | Ron | |
| 11-Oct-72 | A-6A | USMC | O-2 | Unknown | NVN | |

| | | | | | | |
|-----------|--------|------|-----|-----|---------|------------------|
| 12-Oct-72 | F-4E | USAF | O-3 | MiG | Kep | MiG-21 |
| 16-Oct-72 | F-111A | USAF | O-3 | AAA | Dia Loi | Night/Bomb Frag? |

Source: Chris Hobson, Vietnam Air Losses: United States Air Force, Navy and Marine Corps Fixed Wing Aircraft Losses in SEA 1961-1973 (Hinckley, England: Midland, 2001).

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